# **PHILIPS**

Data handbook



Electronic components and materials

Semiconductors

Book S7

1987

Surface mounted semiconductors



# SURFACE MOUNTED SEMICONDUCTORS

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SELECTION GUIDE

## SELECTION GUIDE

### GENERAL PURPOSE TRANSISTORS in SOT-23/SOT-89\*/SOT-143\*\*

		RATII	NGS		hϝ	Е	V	CEsat	f <sub>T</sub>	
type	V <sub>CBO</sub>	V <sub>CEO</sub>	mA IC	P <sub>tot</sub> mW	min./max. a	nt I <sub>C</sub> /V <sub>CE</sub>		mA	typ. MHz	page
P-N-P										
BC807	45	45	500	310	100/600	100/1	0,70	500/50	100	149
BC808	25	25	500	310				21 d		149
BC856	65	65	100	200	75/475	2/5	0,30	10/0,5	150	183
BC857	45	45	100	200	75/475	2/5	0,30	10/0,5	150	183
BC858	30	30	100	200	75/800	2/5	0,30	10/0,5	150	183
BC869*	20	20	1000	1000	85/375	500/1	0,50	1000/100	60	207
BCV26	40	30	300	350	> 20 000	100/5	1,0	100/0,1	220	24
BCV62**	30	30	100	200	100/800	2/5	0,65	100/5	150	249
BCV63**	30	30	100	300	100/900	2/5	0,65	100/5	200	253
BCV64**	30	30	100	300	100/900	2/5	0,30	100/0,5	200	25
BCV65**	30	30	100	300	75/800	2/5	0,30	10/0,5	100	26
BCW29	32	32	100	350	120/260	2/5	0,30	10/0,5	150	26
BCW30					215/500					26
BCW61A	32	32	200	150	120/220	2/5	0,25	10/0,25	180	28
BCW61B					180/310					28
BCW61C					250/460					28
BCW61D					380/630					28
BCW69	50	45	100	350	120/260	2/5	0,30	10/0,5	150	29
BCW70					120/500					29
BCW89	80	60			120/260					31
BCX17	50	45	500	425	100/600	100/1	0,62	500/50	100	31
BCX18	30	25								31
BCX51*	45	45	1000	1000	40/250	150/2	0,50	500/50	-50	32
BCX52*	60	60			40/160		-			32
BCX53*	100	80			40/160					32
BCX71G	45	45	200	150	120/220	2/5	0,25	10/0,25	180	34
BCX71H	45	45	200	150	180/310					34
BCX71J	45	45	200	150	250/460					34
BCX71K	45	45	200	150	380/630					34
PMBTA55	60	60	500	300	50	10/1	0,25	100/10	50	76
PMBTA56	80	80	500	300	50	10/1	0,25	100/10	50	76
PMBTA63	30	30	500	300	5,000	10/5	1,5	100/0,1	125	77
PMBTA64	30	30	500	300	5,000	10/5	1,5	100/0,1	125	77

<sup>\*</sup> Types in SOT-89 package.

<sup>\*\*</sup> Types in SOT-143 package.

### GENERAL PURPOSE TRANSISTORS in SOT-23/SOT-89\*/SOT-143\*\*

		RATIN	GS		hFE	E '	V	CEsat	fT	
type	V <sub>CBO</sub>	V <sub>CEO</sub>	nA	P <sub>tot</sub> mW	min./max. a	t I <sub>C</sub> /V <sub>CE</sub> mA/V		mA	typ. MHz	page
N-P-N										
BC817	45	45	500	310	100/600	100/1	0,70	500/50	200	155
BC818	25	25	500	310	İ					155
BC846	65	65	100	200	220/800	2/5	0,25	10/0,5	300	161
BC847	45	45	100	200			Ì			161
BC848	30	30	100	200						161
BC868*	20	20	1000	1000	85/375	500/1	0,50	1000/100	60	201
BCV27	40	30	300	350	> 20 000	100/5	1,0	100/0,1	220	243
BCV61**	30	. 30	100	200	100/800	2/5	0,60	100/5	300	245
BCV71	80	60	100	350	110/220	2/5	0,25	10/0,5	300	265
BCV72					200/450					265
BCW31	32	32	100	350	110/220	2/5	0,25	10/0,5	300	277
BCW32					200/450					277
BCW33					420/800					277
BCW60A	32	32	200	150	120/220	2/5	0,35	10/0,25	250	285
BCW60B					180/310					285
BCW60C					250/460					285
BCW60D					380/630				-	285
BCW71	50	45	100	350	110/220	2/5	0,25	10/0,5	300	301
BCW72					220/450					301
BCW81					450/800					309
BCX19	50	45	500	425	100/600	100/1	0,62	500/50	200	323
BCX20	30	25								323
BCX54*	45	45	1000	1000	45/250	150/2	0,50	500/50	130	333
BCX55*	60	60			40/160					333
BCX56*	100	80			40/160					333
BCX70G	45	45	200	150	120/220	2/5	0,35	10/0,25	250	337
BCX70H					180/310					337
BCX70J					250/460					337
BCX70K					380/630		1			337

<sup>\*</sup> Types in SOT-89 package.

<sup>\*\*</sup> Types in SOT-143 package.

# SELECTION GUIDE

### GENERAL PURPOSE TRANSISTORS in SOT-23/SOT-89\*/SOT-143\*\*

type	V <sub>CBO</sub>	RATI VCEO V		P <sub>tot</sub>	h <sub>F</sub> min./max. a	-		CEsat at IC/IB mA	f <sub>T</sub> typ. MHz	page
N-P-N			-							
PMBT6428	60	50	200	350	250/600		0,2	10/0,5	300	757
PMBT6429	55	45	200	350	500/1250		0,2	10/0,5	300	757
PMBTA05	60	60	500	300	50	10/1	0,25	100/10	100	761
PMBTA06	80	80	500	300	50	10/1	0,25	100/10	100	761
PMBTA13	30	30	300	300	5,000	10/5	1,5	100/0,1	125	763
PMBTA14	30	30	300	300	10,000	10/5	1,5	100/0,1	125	763

### **HIGH-FREQUENCY TRANSISTORS in SOT-23**

					r		T		T:	T -	
		RATI	NGS			FE	İ	F	fT	Cre	
type	VCBO	<b>VCEO</b>	1C	P <sub>tot</sub>	min./max.	at I <sub>C</sub> /V <sub>CE</sub>	typ	at f	typ.	typ.	page
	V	V	mΑ	mW		mA/V	dB	MHz	MHz	pF	
P-N-P											
BF536	30	30	25	200	25/—	1/10	5	200	350	-	351
BF550	40	40	25	200	50/—	1/10	2	0,1	325	0,5	355
BF569	40	35	30	200	25/—	3/10	4,5	800	900	0,33	359
BF579	20	20	25	150	20/—	10/10	4,5	800	1350	0,46	367
BF660	40	30	25	200	30/—	3/10	-	_	650	0,65	379
BF767	30	30	20	200	15/-	3/10	4	800	900	0,3	383
BF824	30	30	25	300	_	-	3	100	450	0,1	399
N-P-N											
BF570	40	15	100	300	>40	10/1	_		> 490	1,6	363
BF840	40	40	25	300					380	0,3	405
BF841	40	40	25	300					380	0,3	405
BFS18	30	20	30	250	35/125	1/10	4	100	200	0,85	525
BFS19	30	20	30	250	65/225	1/10	4	100	260	0,85	525
BFS20	30	20	25	250	40/85	7/10	_		450	0,35	531

<sup>\*</sup> Types in SOT-89 package.

<sup>\*\*</sup> Types in SOT-143 package.

### BROAD-BAND TRANSISTORS in SOT-23/SOT-89\*/SOT-143\*\*

type	V <sub>CBO</sub>	RATII VCEO V	NGS I <sub>C</sub> mA	P <sub>tot</sub> mW	h <sub>F</sub> min./max. a	E t I <sub>C</sub> /V <sub>CE</sub> mA/V		im o. at f MHz	<sup>f</sup> T typ. GHz	C <sub>re</sub> typ. pF	page
P-N-P					12 Year 1000	- The second desirement of the second					
BFT92 BFT93	20 15	15 12	<b>25</b> 35	200 200	20/– 20/-	14/10 30/5	60 60	493,25 493,25	5 5	0,7 1,0	553 559
N-P-N											
BFG67** BFQ17* BFQ18A BFQ19* BFQ67	20 40 25 20 20	10 25 15 15 10	50 150 150 75 50	300 1000 1000 500 180	20/— 25/— 25/— 25/— 100	15/5 150/6 100/10 75/10 15/5	3 60 3	2000  793,25  2000	7,5 1,2 3,6 5,0 7,5	0,5 1,9 1,2 1,3 0,5	433 437 441 445 449
BFR53 BFR92 BFR92A BFR93 BFR93A	18 20 20 15 15	10 15 15 12 12	50 25 25 35 35	250 200 200 200 250	25/— 25/— 40/— 25/— 40/—	50/5 14/10 14/10 30/5 30/5	60 60 60 60	217,0 493,25 793,25 493,25 793,25	2,0 5,0 5,0 5,0 5,0	0,9 0,7 0,35 0,8 0,6	463 473 483 495 505
BFS17 BFT25	25 8	15 5	25 2,5	250 5 50	20/150 20/—	2/1 1/1	45	217 —	1,3 2,3	0,65 0,45	

#### SWITCHING TRANSISTORS in SOT-23/SOT-89\*

Military and the second second	т						T				
type	V <sub>CBO</sub>	RATIN VCEO V	IGS I <sub>C</sub> mA	P <sub>tot</sub> mW	h <sub>F</sub> min./max.	E at I <sub>C</sub> /V <sub>CE</sub> mA/V	max V	CEsat c. at I <sub>C</sub> /I <sub>B</sub> mA/mA			pag
P-N-P			***************************************								-
BSR12 BSR15 BSR16 BSR18 BSR18A	15 60 60 40 40	15 40 60 40 40	100 600 200 200	250 425 250 250	30/120 100/300 50/150 100/300	50/1 150/10 10/1 10/1	0,45 1,6 0,40 0,4	100/10 500/50 50/5 50/5	20/30 45/100 70/250 70/300	30/3 150/15 10/1 10/1	581 593 593 603
BSR20 BSR20A BSR30* BSR31* BSR32*	130 160 70 70 90	120 150 60 60 80	600 600 1000	350 350 1000	40/180 60/240 40/120 100/300 40/120	10/5 10/5 100/5	0,5 0,5 0,5	50/5 50/5 500/50	500/650	100/5	611 611 615 615
BSR33* BSS63 BST60* BST61* BST62*	90 110 60 80 100	80 100 45 60 80	100 500	350 1000	100/300 30/— 1000/—	25/1 150/10	0,25 1,3	25/2,5 500/0,5	_ 400/1500	_ 500/0,5	615 627 653 653 653
PMBT3906 PXT3906	40 40	40 40	200 200	300 1000	100/300 100/300	10/1 10/1	0,25 0,25	10/1 10/1	35/225 35/225	10/1 10/1	753 783

Types in SOT-89 package are denoted by an asterisk (\*).
 \*\* Types in SOT-143 package are denoted by two asterisks (\*\*).

# SELECTION GUIDE

### SWITCHING TRANSISTORS in SOT-23/SOT-89\*

		RATII	NGS		hF	F	V	CEsat	t (ma	x.)	T
type	V <sub>CBO</sub> V	V <sub>CEO</sub>	I <sub>C</sub> mA	P <sub>tot</sub> mW	min./max. a				on/off at		page
N-P-N											
BSR13	60	30	800	425	100/300	150/10	1,6	500/50	35/285	150/—	587
BSR14	75	40			4.1		1,0				587
BSR17	60	40	200	350	50/150	10/1	0,3	50/5	70/225	10/1	599
BSR17A	60	40	200	350	100/300	10/1	0,3	50/5	70/250	10/1	599
BSR19	160	140	600	350	60/250	10/5	0,25	50/5			607
BSR19A	180	160	600	350	80/250	10/5	0,20	50/5			607
BSR40*	70	60	1000	1000	40/120	100/5	0,5	500/50	250/1000	100/5	619
BSR41*					100/300						619
BSR42*	90	80	1000	1000	40/120	100/5	0,5	500/50	250/1000	100/5	619
BSR43*					100/300						619
BSS64	120	80	100	350	20/80	10/1	0,2	50/15	/1000	15/1	633
BST50*	60	45	500	1000	1000/—	150/10	1,3	500/50	400/1500	500/0.5	1
BST51*	80	60	500	1000			'				649
BST52*	100	80	500	1000							649
BSV52	20	12	100	250	40/120	10/1	0,2	50/5	12/18	10/3	681
									h.		1
PMBT3903	60	40	200	300	50/150	10/1	0,3	50/5	35/175	10,1	749
PMBT3904	60	40	200	300	100/300	10/1	0,3	50/5	35/200	10,1	749
PXT3904*	60	40	200	1000	100/300						779

### LOW-NOISE TRANSISTORS in SOT-23 (F < 4 dB at f = 1 kHz; B = 200 Hz)

		RATIN	IGS		hFi		٧٥	CEsat	fŢ	
type	V <sub>CBO</sub>	V <sub>CEO</sub>	I <sub>C</sub> mA	P <sub>tot</sub> mW	min./max. a			mA	typ. MHz	page
P-N-P						1				
BC859	30	30	100	200	125/800	2/5	0,3	10/0,5	150	191
BC860	45	45	100	200	125/800	2/5	0,3	10/0,5	150	191
BCF29	32	32	100	350	120/260	2/5	0,3	10/0,5	150	213
BCF30	32	32	100	350	215/500	2/5	0,3	10/0,5	150	213
BCF70	50	45	100	350	215/500	2/5	0,3	10/0,5	150	229
N-P-N										
BC849	30	30	100	200	450/800	2/5	0,25	10/0,5	300	171
BC850	45	45	100	200						171
BCF32	32	32	100	350	200/450	2/5	0,25	10/0,5	300	221
BCF33	32	32	100	350	420/800	2/5	0,25	10/0,5	300	221
BCF81	50	45	100	350	420/800	2/5	0,25	10/0,5	300	237

<sup>\*</sup> Types in SOT-89 package are denoted by an asterisk (\*).

### HIGH-VOLTAGE TRANSISTORS in SOT-23/SOT-89\*

Account of the Control of the Contro		RATI	NGS		hF		V	'CEsat	fT	
type	V <sub>CBO</sub>	V <sub>CEO</sub>	I <sub>C</sub>	P <sub>tot</sub> mW	min./max. a	mA/V mA/V	max V	mA mA	min. MHz	page
P-N-P										
BF621*	300		20	1000	50/	25/20	0,8	30/5	60	375
BF623*	250	250	20	1000	50/	25/20	0,8	30/5	60	375
BF821	300		50	310	50/	25/20	0,8	30/5	60	393
BF823	250	250	50	310	50/—	25/20	0,8	30/5	60	393
BST15*	200	200	1000	1000	30/150	50/10	2,5	50/5	15	641
BST16*	350	300	1000	1000	30/120	50/10	2,0	50/5	15	641
PMBTA92	300	300	500	300	40/	10/10	0,5	20/2	50	773
PMBTA93	200	200	500	300	40/—	10/10	0,5	20/2	50	773
N-P-N										
BF620*	300		20	1000	50/—	25/20	0,6	30/5	60	371
BF622*	250	250	20	1000	50/—	25/20	0,6	30/5	60	371
BF820	300		50	310	50/—	25/20	0,6	30/5	60	387
BF822	250	250	50	310	50/	25/20	0,6	30/5	60	387
BST39*	350	300	1000	1000	40/160	20/10	0,5	50/4	70	645
BST40*	350	250	1000	1000	40/160	20/10	0,5	50/4	70	645
PMBTA42	300	300	500	310	40/	30/10	0,5	20/2	50	765
PMBTA43	200	200	500	310	40/—	30/10	0,5	20/2	50	765

<sup>\*</sup> Types in SOT-89 package are denoted by an asterisk (\*).

## SELECTION GUIDE

FIELD-EFFECT TRANSISTOR in SOT-23/SOT-143\*/SOT-89\*\*

		RATING	GS		-IGSS	IDSS	-V(P)GS	y fs	Cre	Vn	
type	± V <sub>DS</sub>	−Vgso V	ID mA	P <sub>tot</sub> mW	max. nA	min./max. mA	max. V	min. mS	max. pF	max. μV	page
BF510	80		30	300						-	0.45
	80	Amer Visi	30	300	10	0,7/3,0	0,8	2,5	0,4	-	345 345
BF511						2,5/7,0	1,5	4			
BF512						6/12	2,2	6			345
BF513						10/18	3	7			345
BF989*	20	- Marine	20	200	50	2/20	2,7	9,5	0,025	-	407
BF990*	18	wases	30	200	25	_	1,3	17	0,025		409
BF991*	20		20	200	50	4/25	2,5	10	0,020	_	413
BF992*	20		40	200	25	_	1,3	20	0,04	man a	415
BF994*	20	moun	30	200	50	2/20	2,5	15	0,025		417
BF994S*	20		50	300	50	4/20	2,5	15	0,025	-	421
BF996*	20	-	30	200	50	2/20	2,5	15	0,025		423
BF996S*	20		30	300	50	4/20	2,5	15	0,025		427
BF997*	20		30	300	10	2/20	2,5	15	0.025		429
BFR30	25	25	10	250	0,2	4/10	5	1	1,5	0.5	453
BFR31		20	10	200	0,2	1/5	2,5	1,5	1,0	0,0	453
BFR101A*	30	30	10	200		0.0/1.5	1.0	1.0			517
BFR101B*					5	0,2/1,5	1,0	1,2	_	-	
	30	30	10	200	5	1/5	2,5	2,5	4.5	-	517
BFT46	25	25	10	250	0,2	0,2/1,5	1,0	1,0	1,5	0,5	545
BSD20*	10		50	230	1,0	_	2,0	_	0,6	_	577
BSD22*	20	_	50	230	1,0	- :	2,0	-	0,6	_	577
BSR56	40	40		250	. 1	50/-	10		5	_	623
BSR57						20/100	6				623
BSR58						8/80	4				623
BSS83*	10		50	230	10	_	2,0		0,6	_	63
BST80**	80	20	500	1000	100	-/0,01	-	300	8	-	65
BST82	80	20	175	300	100	-/0,001	3,5	150	3	_	66
BST84**	200	20	250	1000	100	-/0,01	_	250	5	_	66
BST86**	180	20	300	1000	100	<b>-/0,01</b>		250	6	_	669
BST120**	60	20	300	1000	100	-/0,01 /0,01	_	200	8	1_	673
BST122**	50	20	250	1000	100	-/0,01 -/0,01	_	125	8	_	67
PMBF4391	40	40	******	250	1	50/150	10	_	3,5	_	73
PMBF4392	40	40		250	1	25/75	5	_	3,5	_	73
PMBF4393	40	40		250	1	5/30	3		3,5	_	73
רפסד ומואו ו	70	40		200	'	5/30	3		3,5		1,3

<sup>\*</sup> Types in SOT-143 package are denoted by an asterisk (\*).

<sup>\*\*</sup> Types in SOT-89 package are denoted by two asterisks (\*\*).

### TRIGGER DEVICES

P-N-P-N	case	V <sub>GA</sub> max. V	I <sub>A</sub> max. mA	l <sub>P</sub> μA	Ι <sub>V</sub> μΑ	page
BRY61	SOT-23	70	175	5/1	30/50	565
BRY62	SOT-143	70	175	-	—	571

### **DIODES in SOT-23 unless indicated**

		RAT	INGS	t <sub>rr</sub>	V <sub>F max.</sub>	mV)	C <sub>d</sub>	
type	description	V <sub>R</sub>	ΙĘ	max.	at IF = n		max.	page
***		V	mΑ	ns	10/100 -	150		
BA682**	band switch	35	100	_	<b>-/1000</b>	_	1,5	63
BA683**	band switch	35	100	_	<b>-/1000</b>		1,5	63
BAS16	high-speed switch	75	250	6	855/-	1250	2	65
BAS17	low-voltage stabilizer	-	250		830/960	_ ,	140	69
BAS19	high-speed switch	100	200	50	_/1000	<del>-</del> .	5	73
BAS20	high-speed switch	150	200	50	<b>-/1000</b>	-	5	73
BAS21	high-speed switch	200	200	50	<b>-/1000</b>	_	5	73
BAS28*	fast switch double diode	75	250	6	855/-	1250	2	81
BAS29	switch	90	250	50	750/900		35	85
BAS31	two diodes in series	90	250	50	750/900		35	85
BAS32**	high-speed switch	75	200	4	<b>-/1000</b>	_	2	87
BAS35	common anode double diode	90	250	50	750/900	_	35	85
BAS56*	ultra-high-speed switch							
	double diode	60	200	6	750/—	_	2,5	95
BAT17	Schottky barrier	4	30	-	600/	-	1	99
BAT18	band switch	35	100		/1200	_	1	103
BAT54	Schottky barrier	30	200	5	400/1000	_	10	107
BAT74*	Schottky barrier; double diode	30	200	5	400/1000	_	10	111
BAV23*	two diodes	200	200	50	<b>-/1000</b>	_	2,5	115
BAV70	common cathode double diode	70	250	6	855/-	1250	1,5	117
BAV99	two diodes in series	70	250	6	855/—	1250	1,5	121
BAV100**	general purpose	50	250	50	<b>-/1000</b>		5	125
BAV101**	general purpose	100	250	50	<b>-/1000</b>	_	5	125
BAV102**	general purpose	150	250	50	<b>-/1000</b>	_	5	125
BAV103**	general purpose	200	250	50	<b>-/1000</b>		5	125
BAW56	common anode double diode	70	250	6	855/-	1250	2	133

<sup>\*</sup> SOT-143.

<sup>\*\*</sup> SOD-80.

## SELECTION GUIDE

### VARIABLE CAPACITANCE DIODES SOT-23 and SOD-80 ◀

	RAT	INGS		CHARACTERISTICS						
type	V <sub>R</sub>	۱F	C <sub>d</sub> at V <sub>l</sub>	R	C <sub>d</sub> ratio at V <sub>R</sub> = 3/25 V	rD	page			
	V	mA	pF	٧	at f = 1 MHz	Ω				
BB215◀ BB219◀ BBY31 BBY40	30 32 28 28	20 20 20 20	1,8 - 2,2 2,6 - 3,2 1,8 - 2,8 4,3 - 6	28 28 25 25	typ. 8,3 12 to 15 typ. 5 5 to 5,6	typ. 0,63 typ. 0,7 < 1,2 < 0,6	137 139 141 145			

### **VOLTAGE REGULATOR DIODES**

4			voltage	P <sub>tot</sub>	<sup>I</sup> ZRM	<sup>I</sup> FRM	max. V	Fat IF	697
type	case	range (V)	tolerance %	mW	mA	mA	V	mA	page
BZD27 BZV49 BZV55 BZX84	SOD-87 SOT-89 SOD-80 SOT-23	3,9 to 270 2,4 to 75 2,4 to 75 2,4 to 75	5 5 5 5*	2300 1000 500 350	 **  250	- 250 250 250	- 1 0,9 0,9	- 50 10 10	697 701 711 725

#### **RECTIFIER DIODES**

type	case	IF(AV) A	V <sub>RRM</sub> V	VR V	IFRM A	IFSM A	t <sub>rr</sub> ns	V <sub>F</sub> at	l <sub>F</sub>	page
BYD17D	SOD-87	1,5	200	200	5,5	20	_	1,05	1	693
BYD17G	SOD-87	1,5	400	400	5,5	20	_	1,05	1	693
BYD17J	SOD-87	1,5	600	600	5,5	20	_	1,05	1	693
BYD17K	SOD-87	1,5	800	800	5,5	20	_	1,05	1	693
BYD17M	SOD-87	1,5	1000	1000	5,5	20		1,05	1	693
BYD37D	SOD-87	1,5	200	200	12	20	250	1,3	1	697
BYD37G	SOD-87	1,5	400	400	12	20	250	1,3	1	697
BYD37J	SOD-87	1,5	600	600	12	20	250	1,3	1	697
BYD37K	SOD-87	1,5	800	800	12	20	300	1,3	1	697
BYD37M	SOD-87	1,5	1000	1000	12	20	300	1,3	1	697

<sup>\*</sup> Types with 2% tolerance available on request.

<sup>\*\*</sup> IZRM limited by PZRMmax.

In this alpha-numeric list we present all surface mounted devices mentioned in this handbook.

type number	SOT-23	SOT-89	SOT-143	SOD-80	marking type reverse type	device type	nearest complement	page
BA682 BA683	-	-	-	•	red band red and	diode diode	BA482 BA483	63 63
BAS16 BAS17	•	_	-	-	orange A6 A91	diode diode	BAW62, 1N4148 BA314	65 69
BAS19 BAS20 BAS21 BAS28 BAS29	•	- - -	- - -	-	A8 A81 A82 A61 L20	diode diode diode 2 diodes diode	BAV19 BAV20 BAV21 1N4148 BAX12	73 73 73 81 85
BAS31 BAS32 BAS35 BAS56 BAT17	•		- - - •	•	L21 black band L22 L51 A3	2 diodes diode 2 diodes 2 diodes diode	BAX12 1N4148 BAX12 BAV10 BA480	85 87 85 95 99
BAT18 BAT54 BAT74 BAV23 BAV70	-		•	-	A2 L4 L41 L30 A4	diode diode 2 diodes 2 diodes 2 diodes	BA482 BAT85 BAT85 BAV21 BAW62, 1N4148 (double)	103 107 111 115 117
BAV99 BAV100	-	_ '	-	•	A7 green and black	2 diodes diode	BAW62, 1N4148 (double) BAV10	121 125
BAV101	-	-	_	•	green and brown	diode	BAV19	125
BAV102	-	-	-	•	green and	diode	BAV20	125
BAV103		-	-	•	green and orange	diode	BAV21	125
BAW56	•	-			A 1	diode	BAW62, 1N4148 (double)	133
BB215	- 1	÷ ;	-	•	white and green	diode	BB405B	137
BB219 BBY31 BBY40	•	_	-	•	white S1 S2	diode diode diode	BB909 BB405 BB809	139 141 145
BC807-16 -25 -40 BC808-16 -25	•	-	-	-	5A 5AR 5B 5BR 5C 5CR 5E 5ER 5F 5FR	PNP PNP PNP PNP PNP	BC327-16	149 149 149 149 149

type	-23	-88	SOT-143	08-	mark type		device	nearest	complement	pag
number	SOT-23	SOT-89	SOT	SOD-80	l .	reverse type	type	conventional type(s)		
BC808-40	•	-	_		5G	5gR	PNP	BC328-40	BC818-40	149
BC817-16	•	-	-	-	6A	6AR	NPN	BC337-16	BC807-16	155
-25	•	-	-	-	6B	6BR	NPN	-25	-25	155
-40	•		-		6C	6CR	NPN	-40	-40	155
BC818-16	•		-	-	6E	6ER	NPN	BC328-16	BC808-16	155
BC818-25	•		-	-	6F	6FR	NPN	BC328-25	BC808-25	155
-40	•	-	-		6G	6GR	NPN	-40	-40	155
BC846A	•	-	-	- '	1A	1AR	NPN	BC546A	BC856A	161
BC846B	•		-	-	1B	1BR	NPN	BC546B	BC856B	161
BC847A	•	_	-	-	1E	1ER	NPN	BC547A, BC107A	BC857A	161
BC847B	•	-	-	-	1F	1FR	NPN	BC547B, BC107B	BC857B	161
BC847C	•	-	-	-	1G	1GR	NPN	BC547C	BC857C	161
BC848A	•	-	-	. —	1J	1JR	NPN	BC548A, BC108A	BC858A	161
BC848B	•	-	-	-	1K	1KR	NPN	BC548B, BC108B	BC858B	161
BC848C	•		-	-	1L	1LR	NPN	BC548C, BC108C	BC858C	161
BC849B	•	-	-	_	2B	2BR	NPN	BC549B, BC109B	BC859B	171
BC849C	•		_	-	2C	2CR	NPN	BC549C, BC109C	BC859C	171
BC850B	•	-	-		2F	2FR	NPN	BC550B, BCY59	BC860B	171
BC850C		-	-	~	2G	2GR	NPN	BC550C, BCY59	BC860C	171
BC856A	•	-	-	-	3 <b>A</b>	3AR	PNP	BC556A	BC846A	183
ВС856В	•			_ '	3B	3BR	PNP	BC556B	BC846B	183
BC857A	•	-	_	_ '	3E	3ER	PNP	BC557A, BC177A	BC847A	183
BC857B	•	-	-	~	3F	3FR	PNP	BC557B, BC177B	BC847B	183
BC857C	•	-	-	-	3G	3GR	PNP	BC557C	BC847C	183
BC858A	•		-	-	3J	3JR	PNP	BC558A, BC178A	BC848A	183
BC858B	•	-		- ,	3K	3KR	PNP	BC558B, BC178B	BC848B	183
BC858C	•	~-		-	3L	3LR	PNP	BC558C	BC848C	183
BC859A	•	-	-	-	4A	4AR	PNP	BC559A, BC179A, BCY78		191
BC859B	•	-		-	4B	4BR	PNP	BC559B, BCY79	BC849B	191
BC859C	•	-		-	4C	4CR	PNP	BC559C, BCY79	BC849C	191
BC860A	•	_	-	-	4E	4ER	PNP	BC560A, BCY79		191
BC860B	•	-	-	-	4F	4FR	PNP	BC560B, BCY79	BC850B	191
BC860C	•	-	-	-	4G	4GR	PNP	BC560C, BCY79	BC850C	191
BC868	-	•	-	-	CAC	81	NPN	BC368, BD329	BC869	201
BC869	-	•	-	-	CEC		PNP	BC369, BD330	BC868	207
BCF29	•	-	_	_	C7	C77	PNP	BC559A, BCY78, BC179		213
BCF30	•	-	~	_	C8	C9	PNP	BC559B, BCY78	BCF32	213
BCF32	•	_	-		D7	D77	NPN	BC549B, BCY58, BC109	BCF30	221
BCF33	•	_		_	D8	D81	NPN	BC549C, BCY58		221
BCF70	•	_	_	_	н7	H71	PNP	BC560B, BCY79		229
BCF/U	•		-	-	н/	н/1	PNP	BC300B, BCY/9		22

type number	SOT-23 SOT-89 SOT-143 SOD-80	marking type reverse type	device type	nearest conventional type(s)	complement	page
BCF81 BCV26 BCV27	•	K9 K91 FD FF	NPN PNP NPN	BC550C BC516 BC517	BCV27	237 241
BCV61 BCV62	- · ·,	D91 C91	NPN PNP	BC547 BC557	BCV26 BCV62 BCV61	243 245 249
BCV63 BCV64 BCV65			NPN PNP PNP/NPN		BCV64 BCV63	253 257 261
BCV71 BCV72	•	K7 K71 K8 K81	NPN NPN	BC546A BC546B	BCW89	265 265
BCW29 BCW30 BCW31 BCW32 BCW33	•	C1 C4 C2 C5 D1 D4 D2 D5 D3 D6	PNP PNP NPN NPN NPN	BC178A, BC558A BC178B, BC558B BC108A, BC548A BC108B, BC548B BC108C, BC548C	BCW31 BCW32 BCW29 BCW30	269 269 277 277 277
BCW60A BCW60B BCW60C BCW60D BCW61A	• ,	AA AB AC AD BA	NPN NPN NPN NPN PNP	BC548A BC548B BC548B BC548C BC558A	BCW61A BCW61B BCW61C BCW61D BCW60A	285 285 285 285 289
BCW61B BCW61C BCW61D BCW69 BCW70	•	BB BC BD H1 H4 H2 H5	PNP PNP PNP PNP PNP	BC558B BC558B BC558C BC557A BC557B	BCW60B BCW60C BCW60D BCW71 BCW72	289 289 289 293 293
BCW71 BCW72 BCW81 BCW89 BCX17	•	K1 K4 K2 K5 K3 K31 H3 H31 T1 T4	NPN NPN NPN PNP PNP	BC547A BC547B BC547C BC556A BC327	BCW69 BCW70 BCV71 BCX19	301 301 309 313 317
BCX18 BCX19 BCX20 BCX51 BCX52	•	T2 T5 U1 U4 U2 U5 AA AE	PNP NPN NPN PNP PNP	BC328 BC337 BC338 BC636, BD136 BC638, BD138	BCX20 BCX17 BCX18 BCX54 BCX55	317 323 323 329 329
BCX53 BCX54 BCX55 BCX56 BCX70G		AH BA BE BH AG	PNP NPN NPN NPN NPN	BC640, BD140 BC635, BD135 BC637, BD137 BC639, BD139 BC107A, BC547A	BCX56 BCX51 BCX52 BCX53 BCX71G	329 333 333 333 337

type number	SOT-23 SOT-89 SOT-143 SOD-80	marking type reverse type	device type	nearest conventional type(s)	complement	page
всх70н	•	АН	NPN	ВС107В, ВС547В	всх71н	337
BCX70J	•	AJ	NPN	BC107B, BC547B	BCX71J	337
BCX70K	•	AK	NPN	BC107C, BC547C	BCX71K	337
BCX71G	•	BG	PNP	BC177A, BC557A	BCX70G	341
BCX71H	•	ВН	PNP	BC177B, BC557B	всх70н	341
BCX71J	•	ВЈ	PNP	BC177B, BC557B	всх70Ј	341
BCX71K	•	BK	PNP	BC557C	BCX70K	341
BF510	. •	S6	FET	BF410A		345
BF511	•	S7	FET	BF410B		345
BF512	•	S8	FET	BF410C		345
BF513	•	S9	FET	BF41OD		345
BF536		G3	PNP	BF936		351
BF550	•	G2 G5	PNP	BF450		355
BF569	•	G6	PNP	BF970		359
BF570	•	B26	NPN	BF370		363
BF579	•	G7	PNP	BF979		367
BF620		DC	NPN	BF420, BF471, BF871	BF621	371
BF621		DF	PNP	BF421, BF472, BF872	BF620	375
BF622		DA	NPN	BF422, BF469, BF869	BF623	371
BF623	- •	DB	PNP	BF423, BF470, BF870	BF622	375
BF660	•	G8 G81	PNP	BF606A		379
BF767	•	G9	PNP	BF967		383
BF820	•	1V	NPN	BF420	BF821	387
BF821	•	1W	PNP	BF421	BF820	393
BF822	•	1X	NPN	BF422	BF823	387
BF823	•	1Y	PNP	B <b>F4</b> 23	BF822	393
BF824	• - , - , -	F8	PNP	BF324		399
BF840	•	F3	NPN	BF240		405
BF841		F31	NPN	BF241		405
BF989		M89	FET	BF960		407
BF990	•	M90	FET	BF980		409
BF991		M91	FET	BF981		413
BF992		M92	FET	BF982		415
BF994	• -	M94	FET	BF964		417
BF994S		M93	FET	BF964S		421
BF996	• -	M96	FET	BF966		423
BF996S	• -	M95	FET	BF966S		427
BF997	• 1-	M83	FET			429
BFG67	• -	V3	NPN	BFG65		433
BFQ17	- •	FA	NPN	BFW16A		43

type number	SOT-23	SOT-89	SOT-143	SOD-80	1	everse /pe	device type	nearest conventional type(s)	complement	page
BFQ18A BFQ19 BFQ67	-	•	-		FF FB V2		NPN NPN NPN	BFQ34 BFR96 BFQ65		441 445 449
BFR30 BFR31	•	-	-	-	M1 M2		FET FET	BFW11, BF245 BFW12, BF245		453 453
BFR53 BFR92	•		_		N1 P1	N4 P4	NPN NPN	BF <b>W</b> 3O, BF <b>W</b> 93 BFR9O	BFT92	463 473
BFR92A	•	-	-	_	P2	P5	NPN	BFR90	D1132	483
BFR93	•				R1	R4	NPN	BFR91	BFT93	495
BFR93A	•	-	-	-	R2	R5	NPN	BFR91		505
BFR101A	-	-	•	-	M97	Ì	FET	~		517
BFR101B		-	•	_	M98		FET			517
BFS17 BFS18		_	_	_	E1	E4	NPN	BFY90, BFW92		519
BFS19		~=	-	~	F1 F2	F4 F5	NPN NPN	BF185, BF495 BF184, BF494		525 525
BFS20	•	_	-	_	G1	G4	NPN	BF199		531
BFT25	•	~		-	V1	V4	NPN	BFT24		537
BFT46	•	-		-	М3	ĺ	FET	BFW13, BF245		545
BFT92	•	-	_	_	W1	W4	PNP	BFQ51; 52	BFR92	553
BFT93	•	-	_	-	X1	X4	PNP	BFQ23; 24	BFR93	559
BRY61	•				A5		PNPN	BRY56, BRY39		565
BRY62	•		-	-	A51		PNPN	BRY39		571
BSD20 BSD22	_	•		-	M31		FET	<b>=</b>		577
BSR12				_	M32 B5	в8	FET PNP	2N2894A	BSV52	577 581
	•				ВЭ	ьо	PNP			501
BSR13	•	-	_	_	U7	U71	NPN	2N2222, PH2222	BSR15	587
BSR14	•		_	_	U8	U81	NPN	2N2222A, PH2222A	BSR16	587
BSR15 BSR16			_	_	т7	T71	PNP	2N2907, PH2907	BSR13 BSR14	593
BSR17	•	-	-	-	T8 U9	T81 U91	PNP NPN	2N2907A, PH2907A 2N3903	BSR18	593 599
BSR17A	•	_	-		U92	U93	NPN	2N39O4	BSR18A	599
BSR18	•		_	-	Т9	T91	PNP	2N3905	BSR17	603
BSR18A	•			-	T92	Т93	PNP	2N3906	BSR17A	603
BSR19	•		-		U35		NPN	2N5550	BSR20	607
BSR19A	•	-			U36		NPN	2N5551	BSR20A	607
BSR20	•	-	-	~	Т35		PNP	2N5400	BSR19	611
BSR2OA	•	~~			Т36		PNP	2N5401	BSR19A	611
BSR30	-	•	-	-	BR1		PNP	2N4O3O	BSR40	615
BSR31	-	•			BR2		PNP	2N4032	BSR41	615
BSR32	-	•			BR3		PNP	2N4O31	BSR42	615

type number	SOT-23	SOT-89	SOT-143	SOD-80	1	everse ype	device type	nearest conventional type(s)	complement	page
BSR33	-	•	_	_	BR4		PNP	2 <b>N4</b> 033	BSR43	615
BSR4O	-		_	-	AR1		NPN	BSX46-6	BSR30	619
BSR41	-	•			AR2	ì	NPN	BSX46-16	BSR31	619
BSR42	-	•	-	-	AR3		NPN	2N3O2O	BSR32	619
BSR43	-		-	-	AR4		NPN	2N3019	BSR33	619
BSR56	•	-	-	-	М4		FET	2N4856		623
BSR57			-	-	M5		FET	2N4857		623
BSR58			-	-	M6		FET	2N4858		623
BSS63		-		-	T3	Т6	PNP	BSS68	BSS64	627
BSS64	•	-	-	-	Ω3	U6	NPN	BSS38	BSS63	633
BSS83	-		9		M74		FET			637
BST15	-		-	-	BT1		PNP	2N5415	BST40	641
BST16	-	•		-	BT2	Ì	PNP	2N5416	BST39	641
BST39	-		***		AT1		NPN	2N3439	BST16	645
BST40	-		-	-	AT2		NPN	2N344O	BST15	645
BST50	-			-	AS1		NPN	BSR50, BSS50, BDX42		649
BST51	-		-	-	AS2		NPN	BSR51, BSS51, BDX43		649
BST52			-	_	AS3		NPN	BSR52, BSS52, BDX44		649
BST60	-	•	_	-	BS1		PNP	BSR60, BSS60, BDX45		653
BST61	-	•	-	-	BS2		PNP	BSR61, BSS61, BDX46		653
BST62	-	•	-	-	BS3	1	PNP	BSR62, BSS62, BDX47		653
BST80	-	•			KM	1	FET	BST70A		657
BST82	•			-	02	- 1	FET	BST72A		661
BST84	-	•		-	KN		FET	BST74A		665
BST86	-	•	~	-	KO		FET	BST76A		669
BST120	-	•	_	-	LM		FET			673
BST 122	-	•	-	-	LN	1	FET			677
BSV52	•	~	-	•	B2	В3	NPN	PH2369, BSX20	BSR12	681
BYD17	]				1	I	diode			689
BYD37		S	D-8	37			diode			693
BZD27	]					1	diode			697
BZV49	-		-		*	}	diode	BZV85		701
BZV55			-	•		1	diode	BZX79, BZX55		711
BZX84		-	-	-	*		diode	BZX79, BZX55		725
PMBF4391					M62	-	FET	2N4301		735
PMBF4392	•	-	-	-	M63		FET	2N4392		735
PMBF4393	•	-	_	-	M64		FET	2N4393		735
PMBT2222		-	-	-	P1B		NPN	2N2222	PMBT2907	739
PMBT2222	A .	-			P1P	-	NPN	2N2222A	PMBT2907A	739
PMBT2907		•	-	-	P2B		PNP	2N2907	PMBT2222	743
PMBT2907	A le	-	-		P2F	- 1	PNP	2N2907A	PMBT2222A	743

<sup>\*</sup> For marking of these types see page 20.

type number	SOT-23	SOT-89	SOT-143	SOT-80	marking type reverse	device type	nearest conventional type(s)	complement	page
	S	S	S	S	type	-77-	gontonicional typo(3)		
PMBT3903	•	_			P1Y	NPN	2N39O3	PMBT3905	749
PMBT3904	•		-	-	P1A	NPN	2N39O4	PMBT3906	749
PMBT3906	•	-	-		P2A	PNP	2N3906	PMBT3904	753
PMBT6428	•	_	-	-	P1K	NPN	2N6428		757
PMBT6429	•	-	-		P1L	NPN	2N6429		757
PMBTA05	•	-	_	-	P1H	NPN	MPSAO5	PMBTA55	761
PMBTA06	•		-	-	P1G	NPN	MPSAO6	PMBTA56	761
PMBTA13	•	-		-	P1M	NPN	MPSA13	PMBTA63	763
PMBTA14	•	-		-	P1N	NPN	MPSA14	PMBTA64	763
PMBTA42	•		-	-	P1D	NPN	MPSA42	PMBTA94	765
PMBTA43	•	-		-	P1E	NPN	MPSA43	PMBTA93	765
PMBTA55	•	-	-	-	P2G	NPN	MPSA55	PMBTA05	769
PMBTA56	•	-	-	-	P2H	NPN	MPSA56	PMBTA06	769
PMBTA63	•		-		P2U	PNP	MPSA63	PMBTA13	771
PMBTA64	•	-	-	-	P2V	PNP	MPSA63	PMBTA14	771
PMBTA92	•			-	P2D	PNP	MPSA92	PMBTA42	773
PMBTA93	•	-	-		P2E	PNP	MPSA93	PMBTA43	773
PMLL5225B							1N5225B		
to					ŀ		to		775
PMLL5267B	-	-	-	•		diode	1N5267B		
PXT3904	-	•	-	-	P1A	NPN	2N3904	PXT3906	779
PXT3906	-	•	-		P2A	PNP	2N3906	PXT3904	783

type	BZV49- page 701 SOT-89	BZX84- page 725 SOT-23
device type	diode	diode
nearest conventional type	BZV85 series	BZX79 series
type number suffix	mark	mark
C2V4	2Y4	Z11
C2V7	2Y7	Z12
C3V0	3Y0	Z13
C3V3	3Y3	Z14
C3V6	3Y6	Z15
C3V9	3Y9	Z16
C4V3	4Y3	Z17
C4V7	4Y7	Z1
C5V1	5Y1	Z2
C5V6	5Y6	Z3
C6V2	6Y2	Z4
C6V8	6Y8	Z5
C7V5	7Y5	Z6
C8V2	8Y2	Z7
C9V1	9Y1	Z8
C10	10Y	Z9
C11	11Y	Y1
C12	12Y	Y2
C13	13Y	Y3
C15	15Y	Y4
C16	16Y	Y5
C18	18Y	Y6
C20	20Y	Y7
C22	22Y	Y8
C24	24Y	Y9
C27	27Y	Y10
C30	30Y	Y11
C33	33Y	Y12
C36	36Y	Y13
C39	39Y	Y14
C43	43Y	Y15
C47	47Y	Y16
C51	51Y	Y17
C56	56Y	Y18
C62	62Y	Y19
C68	68Y	Y20
C75	75Y	Y21

# **CONVERSION LIST**

(conventional type number to SMD type number)

conventional type	microminiature type	conventional type	microminiature type	conventional type	microminiature type
BA314	BAS17	BC177	BC857	BC517	BCV27
BA480	BAT17		BCW69/70	BC546	BC846
BA482	BA682	BC177A	BC857A		BCV71/72
BA483	BA683		BCW69	BC546A	BC846A
BAT85	BAT54	BC 177B	BC857B		BCV71
	BAT74		BCW70	BC546B	BC846B
BAV10	BAS56	BC178	BC858		- BCV72
BAV18	BAV100		BCW29/30	BC547	BC847
BAV19	BAS19	BC178A	BC858A		BCW71/71/81
	BAV101		BCW29	BC547A	BC847A
BAV20	BAS20	BC178B	BC858B		BCW71
	BAV 102		BCW30	BC547B	BC847B
BAW62	BAS16	BC179	BC859		BCW72
	BAS28		BCF29/30	BC547C	BC847C
	BAS32	BC179A	BC859A		BCW81
	BAV70		BCF29	BC548	BC848
	BAV99	BC179B	BC859B		BCW31-33
	BAW56		BCF30	BC548A	BC848A
BAX12	BAS29	BC200/01	BC859B		BCW31
	BAS31	,	BCF29	BC548B	BC848B
	BAS35	BC200/02	BC859B/C		BCW32
BB405	BBY31	,	BCF29/30	BC548C	BC848C
BB809	BBY40	BC200/03	BC859C		BCW33
BC107	BC847	,	BCF30	BC549	BC849
	BCW71/72	BC327	BC807		BCF32/33
BC107A	BC847A		BCX17	BC549B	BC849B
	BCW71	BC327-16	BC807-16		BCF32
BC107B	BC847B	BC327-25	BC807-25	BC549C	BC849C
	BCW72	BC327-40	BC807~40		BCF33
BC 108	BC848	BC327A		BC550	BC850
	BCW31-33	BC328	BC808		BCF81
BC108A	BC848A	BC328-16	BC808-16	BC550B	BC850B
	BCW31	BC328-25	BC808-25	BC550C	BC850C
BC108B	BC848B	BC328-40	BC808-40	BC556	BC856
	BCW32	BC337	BC817		BCW89
BC 109	BC849		BCX19	BC556A	BC856A
	BCF32/33	BC337-16	BC817-16		BCW89
BC 109B	BC849B	BC337-25	BC817-25	BC556B	BC856B
	BCF32	BC337-40	BC817-40	BC557	BC857
BC109C	BC849C	BC338	BC818		BCW69/70
	BCFC33		BCX20	BC557A	BC857A
BC146/01	BC849B	BC338-16	BC818-16		BCW69
	BCF32	BC338-25	BC818-25	BC557B	BC857B
BC146/02	BC849B/C	BC338-40	BC818-40		BCW70
	BCF32/33	BC368	BC868	BC557C	BC857C
BC146/03	BC849C	BC369	BC869	BC558	BC858
	BCF33	BC516	BCV26		BCW29/30

# CONVERSION LIST

conventional	microminiature	conventional	microminiature	conventional	microminiatu
type	type	type	type	type	type
BC558A	BC858A	BCY58-IX	BC849B	BD138-16	BCX52-16
	BCW29		BCW60C	BD139	BCX56
BC558B	BC858B	BCY58-X	BC849C	BD139-6	BCX56-6
	BCW30		BCW60D	BD139-10	BCX56-10
BC558C	BC858C	BCY59	BC850	BD139-16	BCX56-16
BC559	BC859		BCX70 fam.	BD140	BCX53
	BCF29/30	BCY59-VII	BCX70G	BD140-6	BCX53-6
BC559A	BC859A	BCY59-VIII	BC850B	BD140-10	BCX53-10
2000011	BCF29		BCX70H	BD140-16	BCX53-16
BC559B	BC859B	BCY59-IX	BC850B	BDX42	BST50
DC33311 .	BCF30	DC100 IN	BCX70J	BDX43	BST50
BC559C	BC859C	BCY59-X	BC850C	BDX43	BST52
		DCI33-A	BCX70K	BDX45	BST60
BC560	BC860	DOVIO			
505.603	BCF70	BCY70	BC860	BDX46	BST61
	. BC860A	D.017.7.4	BCF70	BDX47	BST61
BC560B	BC860B	BCY71	BC860	BF198	
	BCF70		BCF70	BF199	BFS20
BC560C	BC860C	BCY72	BC859	BF240	BF840
BC635	BCX54		BCF29/30	BF241	BF841
BC635-6	BCX54-6	BCY78	BC859	BF324	BF824
BC635-10	BCX54-10		BCW61 fam.	BF370	BSV52
BC635-16	BCX54-16	BCY78-VII	BC859A		BF570
BC636	BCX51		BCW61A	BF41OA	BF510
BC636-6	BCX51-6	BCY78-VIII	BC859A/B	BF410B	BF511
BC636-10	BCX51-10		BCW61B	BF410C	BF512
BC636-16	BCX51-16	BCY78-IX	BC859B	BF410D	BF513
BC637	BCX55		BCW61C	BF419	BST40
BC637-6	BCX556	BCY78-X	BV859C	BF420	BF620
BC637-10	BCX55-10		BCW61D		BF820
BC637-16	BCX55-16	BCY79	BC860	BF421	BF621
BC638	BCX52		BCX71 fam.		BF821
BC6386	BCX52-6	BCY79-VII	BC860A	BF422	BF622
BC638-10	BCX52-10		BCX71G		BF822
BC638-16	BCX52-16	BCY79-VIII	BC860A/B	BF423	BF623
BC639	BCX56		BCX71H	51 105	BF823
BC639-6	BCX56-6	BCY79-IX	BC860B	BF450	BF550
BC639-10	BCX56,-10	DCI'' IN	BCX71J	BF451	B1 330
BC639-16	BCX56-16	BD135	BCX54	BF457	BST40
BC640	BCX53	BD135-6	BCX54-6	BF458	BST40
BC640-6	BCX53-6	BD135-10	BCX54-10	BF459	BST39
BC640-10	•	BD135-10	BCX54-10 BCX54-16	BF469	BF622
BC640-10	BCX53-10				
	BCX53-16	BD136	BCX51 BCX51-6	BF470 BF471	BF623 BF620
BCY56	BC850B	BD136-6			
Day C7	BCF70	BD136-10	BCX51-10	BF472	BF621
BCY57	BC849	BD136-16	BCX51-16	BF494	BFS19
na	BCF32/33	BD137	BCX55	BF494B	BFS19
BCY58	BC849	BD137-6	BCX556	BF495	BFS18
	BCW60 fam.	BD137-10	BCX55-10	BF495C	BFS18
BCY58-VII	BCW60A	BD137-16	BCX55-16	BF495D	BFS18
BCY58-VIII	BC849B	BD138	BCX52	BF606A	BF660
	BCW60B	BD138-6	BCX52-6	BF819	BST40
		BD138-10	BCX52-10	BF857	BST40

# CONVERSION LIST

conventional	microminiature	conventional	microminiature	conventional	microminiature
type	type	type	type	type	type
BF858	BST40	BFY52	BSR40	MPSA14	PMBTA14
BF859	BST39	BFY55	BSR40	MPSA42	PMBTA42
BF869	BF622	BFY90	BFS17	MPSA43	PMBTA43
BF870	BF623	BR101	BRY62	MPSA55	PMBTA55
BF871	BF620	BRY39	BRY62	MPSA56	PMBTA56
BF872	BF621	BRY56	BRY61	MPSA63	PMBTA63
BF926	BF660	BSR50	BST50	MPSA92	PMBTA92
BF936	BF536	BSR51	BST51	MPSA93	PMBTA93
BF939		BSR52	BST52	PH2222	BSR13
BF960	BF989	BSR60	BST60	PH2222A	BSR14
BF964	BF994	BSR61	BST61	PH2369	BSV52
	BF994S	BSR62	BST62	PH2907	BSR15
BF966	BF996	BSS38	BSS64	PH2907A	BSR16
	BF996S	BSS50	BST50	1N4148	BAS16
BF967	BF767	BSS51	BST51		BAV90
BF970	BF569	BSS52	BST52		BAV99
BF979	BF579	BSS60	BST60		BAW56
BF980	BF990	BSS61	BST61	1N5225B	PMLL5225B
BF981	BF991	BSS62	BST62	to	to
BF982	BF992	BSS68	BSS63	1N5267B	PMLL5267B
BFG65	BFG67	BSV15	BSR30/31	2N929	BC850
BFQ23	BFT93	BSV15-6	BSR30	2N930	BNC850
BFQ24	BFT93	BSV15-10	BSR30/31	2.14330	BCF81
BFQ34	BFQ18A	BSV15-16	BSR30/31	2N1613	BSR40
BFQ34T	BFQ18A	BSV16	BSR30/31	2N1711	BSR41
BFQ51	BFT92	BSV16-6	BSR30	2N1893	BSR42
BFQ52	BFT92	BSV16-10	BSR30/31	2N2219	BSR13
BFQ65	BFQ67	BSV16-16	BSR31	2N2219A	BSR14
BFR54	BSV52	BSV17	BSR32/33	2N2213A 2N2222	BSR13
BFR90	BFR92A	BSV17-6	BSR32	2112222	PMBT2222
BFR91	BFR93A	BSV17-10	BSR32/33	2N2222A	BSR14
BFR96	BFQ19	BSX17	BSV52	211222211	PMBT2222A
BFR96S	BFQ19	BSX20	BSV52	2N2297	BSR40
BFT24	BFT25	BSX45	BSR40/41	2N2368	BSV52
BFT44	BST16	BSX45-6	BSR40	2N2369	BSV52
BFT45	BST15/16	BSX45-10	BSR40/41	2N2369A	BSV52
BFW11	BFR30	BSX45-16	BSR41	2N2363A 2N2483	BC850B
BFW12	BFR31	BSX46	BSR40/41	2N2483 2N2484	BC850B/C
BFW13	BFT46	BSX46-6	BSR40	2N2404 2N894A	BSR12
BFW16A		BSX46-10	BSR40/41	2N2905	BSR15
BFW30	BFQ17 BFR53	BSX46-16	BSR41	2N2905A	BSR16
		BSX47	BSR42/43	2N2903A 2N2907	BSR15
BFW92	BFS17 BFR53	BSX47-6	BSR42/43	ZNZ907	PMBT2907
BFW93		BSX47-10	BSR42/43	2N2907A	BSR16
BFX29	BSR16	BSY95A	BSV52	2N2307A	
BFX30	BSR16	BZX55	BZX84	2N3O19	PMBT2907A BSR43
BFX84	BSR40	BZX79	BZX84	2N3019 2N3020	BSR42
BFX85	BSR41	DGAIJ	BZV55	2N3020 2N3053	BSR42 BSR40/41
BFX86	BSR41	D77795	BZV49	2N3053 2N3903	•
BFX87	BSR16	BZV85		2N37U3	BSR17
BFX88	BSR15	MPSAO5 MPSAO6	PMBTAO5	2N3904	PMBT3903 BSR17A
BFY50	BSR40		PMBTA06	2143304	PMBT3904
BFY51	BSR40	MPSA13	PMBTA13		F11D13304

# CONVERSION LIST

conventional	microminiature
type	type
2N3905	BSR18
2N3906	BSR18A
	PMBT3906
2N4030	BSR30
2N4031	BSR32
2N4032	BSR31
2 <b>N4</b> 033	BSR33
2N4123	BSR17
2N4124	BSR18
2N4856	BSR56
2N4857	BSR57
2N4858	BSR58
2N5415	BST15
2N5416	BST16
2N6428	PMBT6428
2N6429	PMBT6429

### MARKING LIST

Types in SOT-23, SOT-89 and SOT-143 envelopes are marked with a code as listed below. The actual type number and data code are on the packing.

Types in SOT-89 usually have the type number marked in full on the envelope. An exception to this is the BZV-49 series.

The envelope number is mentioned in those cases where the same marking code appears twice.

mark type no.	mark	type no.	mark	type no.	mark	type no.
AT1 BST39	BE	BCX55	A2	BAT18	AD	BCX51-16
AT2 BST40	BF	BCX55-6	A3	BAT17	(SOT-	89)
B1	BG	BCX71G	A4	BAV70	AE	BCX52
B2 BSV52	(SOT-	23)	A5	BRY61	AF	BCX52-6
B3	BG	BCX55-10	A51	BRY62	AG	BCX70G
<del></del>	(SOT-	89)				
B4 BSV52R			A6	BAS16		всх70н
B5 BSR12	ВН	BCX71H	A61	BAS28	(SOT-	23)
B6	(SOT-		A7	BAV99	AH	BCX53
B7	BH	BCX56	A8	BAS19	(SOT-	39)
B8 BSR12R	(SOT-		A81	BAS20		BCX70J
	BJ	BCX71J			(SOT-2	23)
B26 BF570	(SOT-		A82	BAS21		
BA BCW61A	1	•	A9	BASZ I	AJ	BCX53-6
(SOT-23)			A91	BAS17	(SOT-	
BA BCX54		BCX56-6	AA		AK	BCX70K
(SOT-89)	(SOT-		(SOT-		(SOT-	
(501-69)	BK	BCX71K	(501-	23)	AK	BCX53-10
	(SOT-	•			(SOT-	
BB BCW61B	BK	BCX56-10	AA	BCX51	(301-	09)
(SOT-23)	(SOT-	89)	(SOT-	89)		
BB BCX54-6	1		AB	BCW60B	AL	BCX53-16
(SOT-89)	BL	BCX56-16	(SOT-	23)	AM	BCX52-16
BC BCW61C	BM	BCX55-16	AB	BCX51-6	AR1	BSR40
(SOT-23)	BR1	BSR30	(SOT-	89)	AR2	BSR41
	BR2	BSR31			AR3	BSR42
BC BCX54-10	BR3	BSR32	A.C.	BCW60C		
(SOT-89)			(SOT-		AR4	BSR43
BD BCW61D	BR4	BSR33		BCX51-10	AS1	BST50
(SOT-23)	BS1	BST60	(SOT-		AS2	BST51
BD BCX54-16	BS2	BST61		BCW6OD	AS3	BST52
(SOT-89)	BS3	BST62	(SOT-		555	D3132
(501 0))	1		(301-	63)		
	A1	BAW56				
	-				-	
	1					
	1 .		1		ı	

# **MARKING**

mark	type no.	mark	type no.	mark	type no.	mark	type no.
BT1	BST15	F3	BF840	К4	BCW71R	M9	CONTRACTOR OF CONTRACTOR CONTRACT
BT2	BST16	F31	BF841	K5	BCW72R	M90	BF990
31	BCW29	F4	BFS18R	К6	200111111	M91	BF991
				K7	BCV71	M92	BF992
22	BCW30	F5	BFS19R			1	
23		F6		K71	BCV71R	M93	BF994S
24	BCW29R	F7		К8	BCV72	M94	BF994
25	BCW3OR	F8	BF824	K81	BCV72R	M95	BF996S
26	DCWJOIL	F9	DIOLI	К9		M96	BF996
27	Danos	1 .	DE0 4.7		BCF81	M97	BFR101A
277	BCF29 BCF29R	FA FB	BFQ17 BFQ19	K91	BCF81R	M98	BFR101B
. / /	DCF 23K	I D	br V 13	KM	BST80	1130	DIRIOID
28	BCF30	FD	BCV26	KN	BST84	N 1	BFR53
29	BCF3OR	FF	BCV27	KO	BST86	N2	
291	BCV62	(SOT-		L2		N3	
CAC	BC868	FF	BFQ18A	L20	BAS29	N4	BFR53R
CEC	BC869	(SOT-		L21	BAS31	N5	~* 210 UZ1
-440	DCGGA	(501-	09)	псі	ו עממט	117	
01	BCW31	G1	BFS20	L22	BAS35	N6	
02	BCW32	G2	BF550	L3		N7	
03	BCW33	G3	BF536	L30	BAV23	N8	
				L4	BAT54	N9	
04	BCW31R	G4	BFS2OR			P1	DED02
)5	BCW32R	G5	BF550R	L41	BAT74	PI	BFR92
06	BCW33R	G6	BF569	L5		P1A	PMBT3904
D <b>7</b>	BCF32	G7	BF579	L51	BAS56	P1B	PMBT2222
077	BCF32R	G8	BF660	LM	BST 120	P1D	PMBTA42
08	BCF33			1		P1E	PMBTA43
		G81	BF66OR	LN	BST122		
D81	BCF33R	G9	BF767	M1	BFR30	P1G	PMBTAO5
091	BCV61	Н1	BCW69	M2	BFR32	P1H	PMBTAO6
)A	BF622	Н2	BCW70	М3	BFT46	P1K	PMBT6428
OB	BF623	Н3	BCW89	M31	BSD20	P1L	
OC .	BF620	i i				1	PMBT6429
OF :		H31	BCW89R	M32	BSD22	P1M	PMBTA13
) <u>E</u>	BF621	Н4	BCW69R	M4	BSR56	P1N	PMBTA14
E1	BFS17	н5	BCW7OR	M5	BSR57	P1P	PMBT2222A
E2	<del></del>	Н6		M6	BSR58	P1Y	PMBT3903
E3		н7	BCF70	M61	. = = = = =	P2	BFR92A
:3 :4	DEC175	H71	BCF70R	M62	PBMF4391	P2A	PMBT3906, PXT390
: 4 : 5	BFS17R	Н8	DCF /UK	M63	PBMF4392	P2B	PMBT2907, PXT390
				- ,			
E6		Н9		M64	PBMF4393	P2D	PMBTA92
E7		K1	BCW71	M74	BSS83	P2E	PMBTA93
E8		К2	BCW72	M8		P2F	PMBT2907A
E.1	BFS18	K3	BCW81	M83	BF997	P2G	PMBTA55
F2	BFS19	K31	BCW81R	M89	BF989	P2H	PMBTA56
	נוניים	231	DC#O IX				

# MARKING

mark	type no.	mark	type no.	mårk	type no.	mark	type no.
P2U	PMBTA63	Т93	BSR18AR	<b>x</b> 9		1E	BC847A
P2V	PMBTA64	U1	BCX19	Y 1	BZX84-C11	1ER	BC847AR
P3	FMDIA04	U2	BCX20	Y2	-C12	1F	BC847B
	DTD 0.0D			1			
P4	BFR92R	U3	BSS64	Y3	-C13	1FR	BC847BR
P5	BFR92AR	U4	BCX19R	Y4	-C15	1G	BC847C
P6		U5	BCX2OR	<b>Y</b> 5	BZX84-C16	1GR	BC847CR
P7		U6	BSS64R	Y6	-C18	1J	BC848A
89		U7	BSR13	¥7	-C20	1JR	BC848AR
9		U8	BSR14	Y8	-C22	1 K	BC848B
R1	BFR93	U81	BSR14R	Y9	-C24		
X I	DFR93	001	751760	13	-024	1KR	BC848BR
R2	BFR93A	U9	BSR17	Y10	BZX84-C27	1L	BC848C
R3		U91	BSR17R	Y11	-C30	1LR	BC848CR
R4	BFR93R	U92	BSR17A	Y12	-c33	1 V	BF820
R5	BFR93AR	U93	BSR17AR	Y13	-C36	1W	BF821
R6		V1		Y14	-C39	1 X	BF822
						4.07	DB022'
R7		V2	BFQ67	Y15	-C43	1Y	BF823
88		<b>V</b> 3	BFG67	Y16	-C47·	2B	BC849B
19		V4	BFT25R	¥17	-C51	2BR	BC849BR
51	BBY31	<b>V</b> 5		Y18	-C56	2C	BC849C
52	BBY40	V6		¥19	-C62	2CR	BC849CR
<b>S</b> 3		V7		Y20	-C68	2F	BC850B
53 S4		V8					
				Y21	-C75	2FR	BC850BR
S5		V9		21	-C4V7	2G	BC850C
56	BF510	W 1	BFT92	Z2	-C5V1	2GR	BC850CR
57	BF511	W2		<b>Z</b> 3	-C5V6	2Y4	BZV49-C2V4
58	BF512	w3		24	-c6v2	2 <b>Y</b> 7	BZV49-C2V7
59	BF513	W4	BFT92R	Z5	-C6V8	3 <b>A</b>	BC856A
:1			DFIJZK	26	-C7V5	3AR	BC856AR
	BCX17	<b>W</b> 5		1			
'2	BCX18	W6		Z7	-C8V2	3B	BC856B
13	BSS63	<b>W</b> 7		Z8 .	-C9V1	3BR	BC856BR
r 4	BCX17R	w8		Z 9	-C10	3E	BC857A
r5	BCX18R	<b>W</b> 9		211	-C2V4	3ER	BC857AR
ľ6	BSS63R	X1	BFT93	Z12	-C2V7	3F	BC857B
r7	BSR15	X2	1111	213	-C3V0	3FR	BC857BR
7.71	BSR15R	X3		Z13	-C3V3	3J	BC858A
. / 1	BORTOR	AJ		214	-6343	30	Decodor
r8	BSR16	X4	BFT93R	Z 15	-c3v6	3JR	BC858AR
Г81	BSR16R	X5		Z16	-C3V9	3G	BC857C
Г9	BSR18	Х6		217	-C4V3	3GR	BC857CR
Г91	BSR18R	<b>X</b> 7		1A	BC846A	3K	BC858B
r92	BSR18A	Х8		1BR	BC846AR	3KR	BC858BR
		,					
				1000			

## **MARKING**

mark	type no.	mark	type no.	mark	type no.	mark	type no.
3L, 3LR 3Y0	BC858C BC858CR BZV49-C3VO	6E 6ER	BC818-16 BC818-16R				
		6F	BC818-25				
3Y3	BZV49-C3V3	6FR	BC818-25R				
3 <b>Y</b> 6	BZV49-C3V6	6G	BC818-40				
3 <b>Y</b> 9	BZV49-C3V9	6GR	BC818-40R				
		1					
4A	BC859A	6Y2	BZV49-C6V2			1	
4AR	BC859AR	6Y8	-C6V8				
4B	BC859B	7Y5	-C7V5				
4BR	BC859BR	8Y2	-C8V2	*		1	
4C	BOSEOG	9Y1	-C9V1				
	BC859C	i .					
4CR	BC859CR	10Y	-C10				
4E	BC860A	11Y	-C11				
4ER	BC860AR	12Y	-C12	-			
4F	BC860B	13Y	-C13				
4FR	BC860BR	15Y	-C15				
4G	BC860C	16Y					
			-C16				
4GR	BC860CR	18Y	-C18				
4Y3	BZV49-C4V3	20Y	-C20				
4Y7	BZV49-C4V7	22Y	-C22				
		0.4**					
5 <b>A</b>	BC807-16	24Y	-C24				
5AR	BC807-16R	27Y	-C27				
5B	BC807-25	30Y	-C30				
5BR	BC807-25R	33Y	-C33				
5C	BC807-40	36Y	-C36				
Ean	D4407 40D	20"	Dau40 a30				
5CR	BC807-40R	39Y	BZV49-C39				
5 <b>E</b>	BC808-16	43Y	-C <b>4</b> 3				
5ER	BC808-16R	47Y	-C <b>4</b> 7				
5 F	BC808-25	51Y	-C51				
5FR	BC808-25R	56Y	-C56				
E @	D0000 40	628	960				
5G	BC808-40	62Y	-C62				
5GR	BC808-40R	68Y	-C68				
5Y1	BZV49-C5V1	75Y	-C75				
5Y6	BZV49-C5V6					į	
6A	BC917-16					1	
6AR	BC817-16R			471.41			
6B	BC817-25			1. 1.			
6BR	BC817-25R						
6C	BC817-40						
6CR	BC817-40R						
						1	
						1	
				l			

### TAPE AND REEL SPECIFICATION

Semiconductors in SOT-23, SOT-143 and SOT-89 encapsulations can be delivered in reel packing for automatic placement on hybrid circuits and printed circuit boards. The devices are placed with the mounting side downwards in compartments.

A separate cross-section for SOD-80 encapsulation is given in Fig. 3.

A separate reel packing for SOT-89 encapsulation is given in Fig. 4.

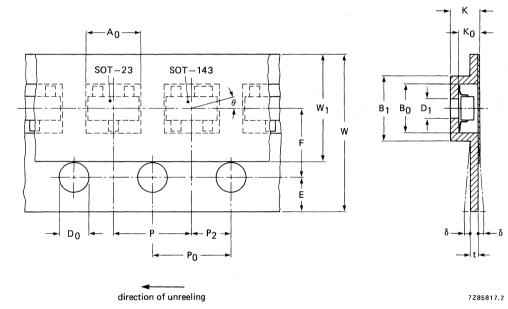


Fig. 1 Configuration of bandolier. Dimensions in mm.

Compartment			tol.	Centre line dimension	ıs		tol.
length width depth width outside pitch deviation hole diameter	-	ponent length ponent width 0,95 3,3 4,0 15 <sup>0</sup>	+ 0,2 + 0,2 + 0,2 max. ± 0,1 max. min.	length direction width direction  Fixing tape width thickness  Carrier tape	P <sub>2</sub> F W <sub>1</sub>	2,0 3,5 5,5 0,1	± 0,05 ± 0,05 ± 0,25 max.
Sprocket hole				width	W	8,0	± 0,2
diameter pitch distance	D <sub>0</sub> P <sub>0</sub> F	1,5 4,0	+ 0,1 ± 0,1	bending thickness	δ t	0,3 0,4	max. max.
cumulative (10)	С	1,75 ± 0.1	± 0,1	Overall thickness	Κ	1,5	max.

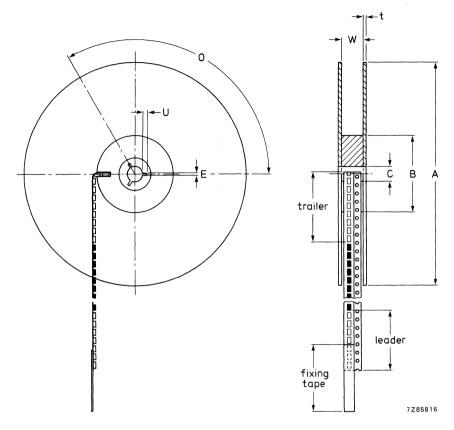


Fig. 2 Configuration of reel and flange (dimensions in mm).

Flange			tol.	Hub			tol.
diameter	Α	180	+ 0 -2	diameter	В	62	± 1,5
	^			spindle hole	С	12,75	+ 0,15 <del>-</del> 0
thickness	t	1,5	+ 0,5 0,1	key slit			
space between flanges	W	9,5	± 0,5	width	Ε	2	± 0,5
				depth	U	4	± 0,5
				location	0	120	degrees

### Amount of devices per reel

The bandolier of a 180 mm reel contains at least 3000 devices with no more than 15 empty compartments (0,5%). Three consecutive empty places might be found provided this gap is followed by 6 consecutive devices.

The carrier tape (leader) starts with at least 75 empty positions (equivalent to 300 mm); the covering foil is at least 300 mm. In order to fix the carrier tape a self-adhesive tape of 20 to 50 mm is applied.

At the end of the bandolier (trailer) at least 75 empty positions (equivalent to a length of 300 mm) and 300 mm foil. For fixing onto the reel a self-adhesive tape of 20 to 50 mm is applied.

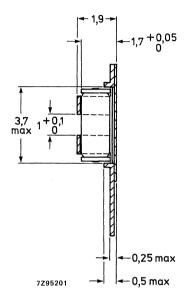


Fig. 3 Cross-sectional view of bandolier with SOD-80 devices.

Note: Testing of SOD-80 devices is possible in this tape. The cathode is directed towards the sprocket hole. The total number of devices per reel is 2500 for SOD-80 and 2000 for SOD-87.

Semiconductors in SOT-89 encapsulations can also be delivered in reel packing for automatic placement on hybrid circuits and printed circuit boards. The devices are placed with the mounting side downwards in compartments. Total number of devices per reel is 1000.

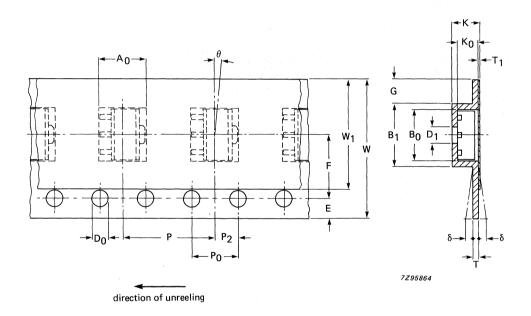


Fig. 4 Configuration of bandolier. Dimensions in mm.

Compartment			tol.	Centre line dimensions			tol.
length	A <sub>0</sub> com	ponent length		length direction	P <sub>2</sub>	2,0	± 0,05
width	B <sub>0</sub> com	ponent width		width direction	F	5,5	± 0,1
depth width outside	K <sub>0</sub> com	ponent depth 5,7	max.	Fixing tape			
pitch	P	8,0	± 0,1	width	W <sub>1</sub>	9,5	max.
deviation	Θ	± 50	max.	thickness	Τ1	0,1	max.
hole diam.	D <sub>1</sub>	1,5	min.	Carrier tape			
Sprocket hole				width	W	12	± 0,2
diameter	$D_0$	1,5	+ 0,1	bending	δ	0,3	max.
pitch	P <sub>0</sub>	4,0	± 0,1	thickness	T	0,4	max.
distance cumulative (10)	E	1,75	± 0,1	Overall thickness	K	2,4	max.
pitch error		± 0,1		distance	G	1,8	min.

# SOLDERING RECOMMENDATIONS SOD80, SOD87, SOT-23, SOT143 AND SOT-89 ENVELOPES

SOT-23, SOT-143 and SOT-89 devices are ideally suited for placement onto thick and thin film substrates and printed circuit boards.

To assure reliable and consistent connections particular attention should be paid to:

#### 1. Flux

A non-active flux is recommended. Where active fluxes are employed, great care in subsequent substrate cleaning must be exercised.

#### 2. Metal-alloy solder or solder paste

Correct choice of solder alloy or solder paste to be employed e.g. 62% Sn, 36% Pb, 2% Ag or 60% Sn/40% Pb. Any paste used should contain at least 85% metal dry weight.

#### 3. Soldering temperature

This will vary according to the actual method employed.

#### **REFLOW SOLDERING**

The preferred technique for mounting microminiature components on hybrid thick and thin-film is the method of reflow soldering.

The tags of SOT-23, SOT-143 and SOT-89 envelopes are pre-tinned and the best results are obtained if a similar solder is applied to the corresponding soldering areas on the substrate. This can be done by either dipping the substrate in a solder bath or by screen printing a solder paste.

The maximum temperature of the leads or tab during the soldering cycle should not exceed 285 °C. The most economic method of soldering is a process in which all different components are soldered simultaneously for example SOT-23, SOT-143 or SOT-89 devices, capacitors and resistors.

Having first been fluxed, all components are positioned on the substrate. The slight adhesive force of the flux is sufficient to keep the components in place. Solder paste contains a flux and has therefore good inherent adhesive properties which eases positioning of the components.

With the components in position the substrate is heated to a point where the solder begins to flow. This can be done on a heating plate or on a conveyor belt running through an infrared tunnel. The maximum allowed temperature of the plastic body of a device must be kept below 280 °C during the soldering cycle. For further temperature behaviour during the soldering process see Figs 2 and 3.

The surface tension of the liquid solder tends to draw the tags of the device towards the centre of the soldering area and has thus a correcting effect on slight mispositionings. However, if the layout leaves something to be desired the same effect can result in undesirable shifts; particularly if the soldering areas on the substrate and the components are not concentrally arranged. This problem can be solved using a standard contact pattern, which leaves sufficient scope for the self-positioning effect (see Figs 4 and 5).

After cooling the connections may be visually inspected and, where necessary, repaired with a light soldering iron. Finally any remaining flux must be removed carefully.

#### WAVE SOLDERING

The normal (dual) wave soldering process can also be applied to SOD-80, SOT-23, SOD-87 and SOT-143 envelopes. We do not recommend SOT-89 for wave soldering.

#### IMMERSION SOLDERING

Where a complete substrate or printed circuit board is immersed in solder:

- a. The temperature of the soldering bath should not exceed 280 °C.
- b. The duration of the soldering cycle should not exceed 10 seconds.
- c. Forced cooling may be applied (see Fig. 1).

#### HAND SOLDERING

It is possible to solder microminiature devices with a light hand-held soldering iron, but this method has obvious drawbacks and should therefore be restricted to laboratory use and/or incidental repairs on production circuits.

- 1. It is time-consuming and expensive.
- The device cannot be positioned accurately and therefore the connecting tags may come into contact with the substrate and damage it.
- 3. There is a great risk of breaking either substrate or even internal connections inside the encapsulation.
- 4. The envelope may be damaged by the iron.

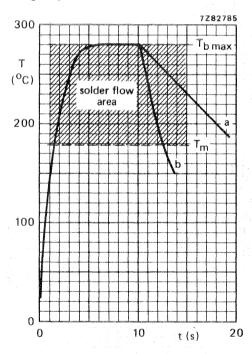


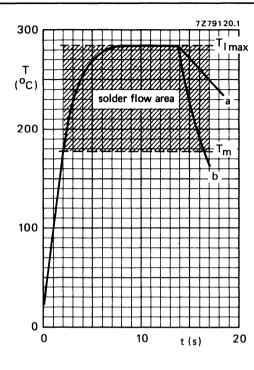
Fig. 1 Device temperature during immersion soldering.

Maximum time of immersion in soldering bath is 10 seconds at an ambient temperature of 25 °C.

a = free convection cooling; b = forced cooling.

T<sub>b max</sub> = maximum bath temperature (280 °C).

T<sub>m</sub> = melting temperature of solder (179 °C).



a = free convection cooling.

b = permissible forced cooling.

T<sub>I max</sub> = Maximum lead or tab temperature = 285 °C.

 $T_m$  = Melting point of the solder is 179 °C.

 $T_{amb} = 25$  °C.

Time of heat supply: without preheating max. 14 s with preheating max. 10 s Maximum time of preheating 45 s

Fig. 2 Reflow soldering without preheating.

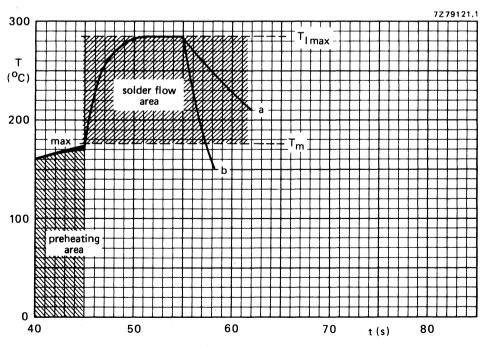


Fig. 3 Reflow soldering with preheating.

## SOLDERING RECOMMENDATIONS

Minimum required dimensions of metal connection pads on hybrid thick and thin-film substrates.

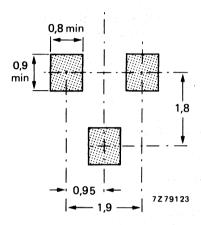


Fig. 4 SOT-23 pattern.

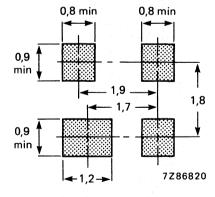


Fig. 6 SOT-143 pattern.

#### Dimensions in mm

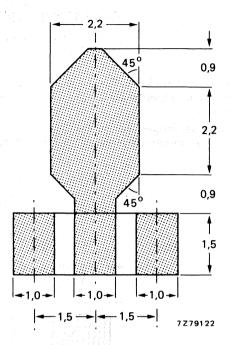


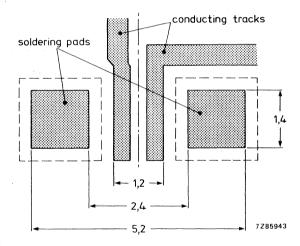
Fig. 5 SOT-89 pattern.

# SOLDERING RECOMMENDATIONS SOD-80 ENVELOPE

The layout shown below is intended for use with mounting of diodes having a SOD-80 envelope onto a printed circuit board in those cases where the diode is glued to the p.c. board first and soldered afterwards.

The dimensions given may be smaller if the diode in question is not fixed to the substrate prior to soldering. The position of the SOD-80 device is then self-adjusted during the soldering process.

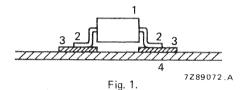
Dimensions in mm





# THERMAL CHARACTERISTICS FOR SOT-23 AND SOT-143 ENVELOPES

The heat generated in a semiconductor chip normally flows by various paths to the surroundings (ambient).



- Heat radiation from the envelope to ambient (1).
   This heat transfer can be neglected when the envelope is mounted on a substrate or printed circuit board.
- 2. Heat transmission via leads (2) soldering points (3) and substrate (4).

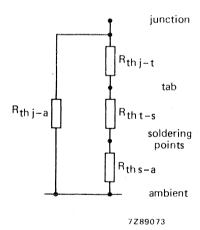


Fig. 2 Thermal behaviour of heat flow when the device is mounted on a substrate or printed circuit board.

R<sub>th i-t</sub> = Thermal resistance from junction to tab.

R<sub>th t-s</sub> = Thermal resistance from tab to soldering points.

R<sub>th s-a</sub> = Thermal resistance from soldering points to ambient.

 $R_{th j-a}$  = Thermal resistance from junction to ambient.

#### Heat transfer directly from envelope to ambient

This depends on the difference between the temperatures of envelope and the surroundings. When the device is mounted on a substrate or printed circuit board direct heat flow can usually be neglected in relation to the heat flow via leads and substrate.

Thus the thermal model can be as in Fig. 3.

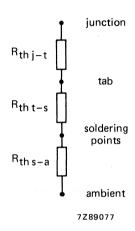


Fig. 3 Basic thermal model.

#### Heat transfer from junction to tab

This is an internal heat transfer and has been measured. In general it is.			
for high-frequency transistors, low-power diodes and (MOS) FETs		60 K	/W
for low-frequency and switching transistors		50 K	/W
for low-frequency medium-power transistors		30 K	/W

#### Heat transfer from tab to soldering points

This value has also been measured for SOT-23 with $P_{tot}$ $\leq$ 350 mW	280 K/W
for types of semiconductors in this envelope with $P_{tot} < 425 \text{ mW}$	260 K/W
for types of semiconductors in a SOT-143 envelope this value is	310 K/W

#### Heat transfer from soldering points to ambient

This depends on the shape and material of tracks and substrate. In figures 4 and 5 standard mounting conditions are given to set up the maximum power ratings for SOT-23 and SOT-143 encapsulations.

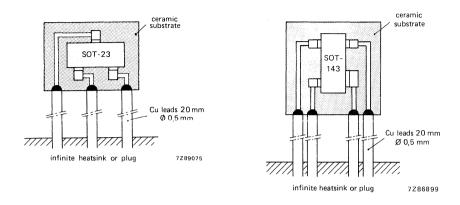


Fig. 4 Test circuits SOT-23 and SOT-143 mounting conditions on a ceramic substrate.

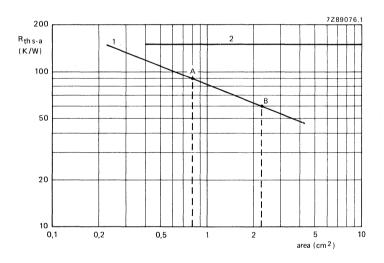


Fig. 5 Heat transfer from soldering points to ambient.

#### 1. Ceramic substrate

Point A on the curve in Fig. 5 is for an area of the ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm for the maximum rating of all high-frequency, low-frequency and switching transistors and also for all diodes.

Point B on the curve in Fig. 5 is for an area of the ceramic substrate of 15 mm  $\times$  15 mm  $\times$  0,7 mm for the maximum rating of low-frequency medium-power semiconductors.

#### 2. Printed circuit board

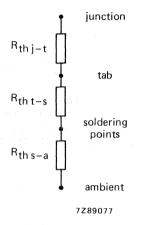
 $R_{th s-a}$  = 150 K/W for SOT-23 and SOT-143 envelopes mounted on a printed circuit board.

## THERMAL CHARACTERISTICS

The values for the thermal resistance from junction to tab, and tab to soldering points, are given earlier and in Fig. 5.

The formula for devices in SOT-23 with one crystal can be generalized:

$$T_j = P(R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$



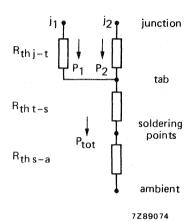


Fig. 6 Thermal model of SOT-23 envelopes with one crystal.

Fig. 7 Thermal model of SOT-23 envelopes with two crystals (double diode).

The formulae for devices with two crystals (double diodes) are:

 $T_{tab} = P_{tot} \cdot (R_{th \ t-s} + R_{th \ s-a}) + T_{amb} = P_{tot} (280 + 90) + T_{amb}$ 

$$T_{i1} = (P_1 \times R_{th i-t}) + T_{tab} = P_1 \cdot 60 + T_{tab}$$

$$T_{i2} = (P_2 \times R_{th \ i-t}) + T_{tab} = P_2 \cdot 60 + T_{tab}$$

As mentioned with Fig. 3:

R<sub>th j-t</sub> for diodes is 60 K/W.

 $R_{th \ s-a}$  (area 8 mm x 10 mm x 0,7 mm) = 90 K/W.

 $R_{th t-s}$  for all semiconductors in SOT-23 = 280 K/W.

Thus:

$$T_{j1} = 60 P_1 + 370 P_{tot} + T_{amb}$$
.

$$T_{j2} = 60 P_2 + 370 P_{tot} + T_{amb}$$
.

## **GENERAL**

Type designation Rating systems Letter symbols s-parameters

# PRO ELECTRON TYPE DESIGNATION CODE FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete semiconductor devices — as opposed to integrated circuits —, multiples of such devices and semiconductor chips.

"Although not all type numbers accord with the Pro Electron system, the following explanation is given for the ones that do."

A basic type number consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

#### FIRST LETTER

The first letter gives information about the material used for the active part of the devices.

- A. GERMANIUM or other material with band gap of 0,6 to 1,0 eV.
- B. SILICON or other material with band gap of 1,0 to 1,3 eV.
- C. GALLIUM-ARSENIDE or other material with band gap of 1,3 eV or more.
- R. COMPOUND MATERIALS (e.g. Cadmium-Sulphide).

#### **SECOND LETTER**

The second letter indicates the function for which the device is primarily designed.

- A. DIODE; signal, low power
- B. DIODE; variable capacitance
- C. TRANSISTOR; low power, audio frequency ( $R_{th\ i-mb} > 15\ K/W$ )
- D. TRANSISTOR; power, audio frequency ( $R_{th\ i-mb} \le 15\ K/W$ )
- E. DIODE; tunnel
- F. TRANSISTOR; low power, high frequency (Rth j-mb > 15 K/W)
- G. MULTIPLE OF DISSIMILAR DEVICES MISCELLANEOUS; e.g. oscillator
- H. DIODE; magnetic sensitive
- L. TRANSISTOR; power, high frequency ( $R_{th\ j-mb} \leq 15\ K/W$ )
- N. PHOTO-COUPLER
- P. RADIATION DETECTOR; e.g. high sensitivity phototransistor
- Q. RADIATION GENERATOR; e.g. light-emitting diode (LED)
- R. CONTROL AND SWITCHING DEVICE; e.g. thyristor, low power (Rthi-mb > 15 K/W)
- S. TRANSISTOR; low power, switching ( $R_{th\,j\text{-}mb} > 15 \text{ K/W}$ )
- T. CONTROL AND SWITCHING DEVICE; e.g. thyristor, power (R<sub>th i-mb</sub> ≤ 15 K/W)
- U. TRANSISTOR; power, switching ( $R_{th\ i-mb} \leq 15\ K/W$ )
- X. DIODE: multiplier, e.g. varactor, step recovery
- Y. DIODE; rectifying, booster
- Z. DIODE; voltage reference or regulator (transient suppressor diode, with third letter W)

## TYPE DESIGNATION

#### **SERIAL NUMBER**

Three figures, running from 100 to 999, for devices primarily intended for consumer equipment.\* One letter (Z, Y, X, etc.) and two figures, running from 10 to 99, for devices primarily intended for industrial/professional equipment.\*

This letter has no fixed meaning except W, which is used for transient suppressor diodes.

#### **VERSION LETTER**

It indicates a minor variant of the basic type either electrically or mechanically. The letter never has a fixed meaning, except letter R, indicating reverse voltage, e.g. collector to case or anode to stud.

#### SUFFIX

Sub-classification can be used for devices supplied in a wide range of variants called associated types. Following sub-coding suffixes are in use:

1. VOLTAGE REFERENCE and VOLTAGE REGULATOR DIODES: ONE LETTER and ONE NUMBER

The LETTER indicates the nominal tolerance of the Zener (regulation, working or reference) voltage

- A. 1% (according to IEC 63: series E96)
- B. 2% (according to IEC 63: series E48)
- C. 5% (according to IEC 63: series E24)
- D. 10% (according to IEC 63: series E12)
- E. 20% (according to IEC 63: series E6)

The number denotes the typical operating (Zener) voltage related to the nominal current rating for the whole range.

The letter 'V' is used instead of the decimal point.

2. TRANSIENT SUPPRESSOR DIODES: ONE NUMBER

The NUMBER indicates the maximum recommended continuous reversed (stand-off) voltage  $V_R$ . The letter 'V' is used as above.

3. CONVENTIONAL and CONTROLLED AVALANCHE RECTIFIER DIODES and THYRISTORS: ONE NUMBER

The NUMBER indicates the rated maximum repetitive peak reverse voltage ( $V_{RRM}$ ) or the rated repetitive peak off-state voltage ( $V_{DRM}$ ), whichever is the lower. Reversed polarity is indicated by letter R, immediately after the number.

- RADIATION DETECTORS: ONE NUMBER, preceded by a hyphen (–)
   The NUMBER indicates the depletion layer in μm. The resolution is indicated by a version LETTER.
- 5. ARRAY OF RADIATION DETECTORS and GENERATORS: ONE NUMBER, preceded by a stroke (/).

The NUMBER indicates how many basic devices are assembled into the array.

\* When these serial numbers are exhausted the serial number for consumer types may be extended to four figures, and that for industrial types to three figures.

#### **BATING SYSTEMS**

The rating systems described are those recommended by the International Electrotechnical Commission (IEC) in its Publication 134.

#### **DEFINITIONS OF TERMS USED**

Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note

This definition excludes inductors, capacitors, resistors and similar components.

Characteristic. A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

Bogey electronic device. An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

Rating. A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Note

Limiting conditions may be either maxima or minima.

Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note

The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

#### ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

## RATING SYSTEMS

#### **DESIGN MAXIMUM RATING SYSTEM**

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

#### **DESIGN CENTRE RATING SYSTEM**

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

#### TRANSISTOR RATINGS

The ratings are presented as voltage, current, power and temperature ratings. The list of these ratings and their definitions is given as follows:

#### Transistor voltage ratings

Collector to base voltage ratings

V<sub>CBmax</sub> The maximum permissible instantaneous voltage between collector and base

terminals. The collector voltage is negative with respect to base in PNP tran-

sistors and positive with respect to base in NPN types.

V<sub>CBmax</sub> (IE = 0) The maximum permissible instantaneous voltage between collector and base

terminals, when the emitter terminal is open circuited.

Emitter to base voltage ratings

VEBmax The maximum permissible instantaneous reverse voltage between emitter and

base terminal. The emitter voltage is negative with respect to base for PNP

transistor and positive with respect to base for NPN types.

 $V_{EBmax}$  ( $I_{C} = 0$ ) The maximum permissible instantaneous reverse voltage between emitter and

base terminals when the collector terminal is open circuited.

Collector to emitter voltage ratings

VCEmax The maximum permissible instantaneous voltage between collector and emitter

terminals. The collector voltage is negative with respect to emitter in PNP transistors and positive with respect to emitter in NPN types. This rating is very dependent on circuit conditions and collector current and it is necessary to refer to the curve of  $\mathsf{V}_\mathsf{CE}$  versus  $\mathsf{I}_\mathsf{C}$  for the appropriate circuit condition

in order to obtain the correct rating.

V<sub>CEmax</sub> (Cut-off) The maximum permissible instantaneous voltage between collector and emitter

terminals when the emitter current is reduced to zero by means of a reverse emitter base voltage, i.e. the base voltage is normally positive with respect to emitter for PNP transistor and negative with respect to emitter for NPN types.

NOTE: The term ''cut-off'' is sometimes replaced by  $V_{BE} > x$  volts, or  $\frac{R_B}{R_E}$ ,  $\leq y$  which are equivalent conditions under which the device may be cut-off.

V<sub>CEmax</sub> (I<sub>C</sub> = x mA) The maximum permissible instantaneous voltage between collector and emitter terminals when the collector current is at a high value, often the max. rated

value.

V<sub>CEmax</sub> (I<sub>B</sub> = 0) The maximum permissible instantaneous voltage between collector and emitter terminals when the base terminal is open circuited or when a very high resistance is in series with the base terminal. Special care must be taken to ensure that thermal runaway due to excessive collector leakage current does not occur in this condition.

Due to the current dependency of V<sub>CE</sub> it is usual to present this information as a voltage rating chart which is a curve of collector current versus collector to emitter voltage (see Fig. 1).

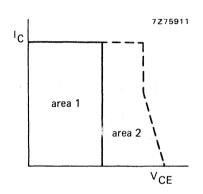
# TRANSISTOR RATINGS

This curve is divided into two areas:

A permissible area of operation under all conditions of base drive provided the dissipation rating is not exceeded (area 1) and an area where operation is allowable under certain specified conditions (area 2). To assist in determining the rating in this second area, further curves are provided relating the voltage rating to external circuit conditions, for example:

$$\frac{R_B}{R_E}$$
 ,  $R_B$  ,  $Z_{Bg}$  ,  $V_{BE}$  ,  $I_B$  or  $\frac{V_{BB}}{R_B}$  .

An example of this type of curve is given in Fig. 2 as  $V_{CE}$  versus  $\frac{R_B}{R_E}$  for two different values of collector current.



 $V_{CE} = 0$   $I_{C} = I_{Cmax}$   $R_{R}/R_{E}$ 

Fig. 1.

Fig. 2.

It should be noted that when  $R_E$  is shunted by a capacitor, the collector voltage  $V_{CE}$  during switching must be restricted to a value which does not rely on the effect of  $R_E$ . In the case of an inductive load and when an energy rating is given, it may be permissible to operate

#### Transistor current ratings

Collector current ratings

Conector current ratings

1Cmax

The maximum permissible collector current. Without further qualification, the

d.c. value is implied.

outside the rated area provided the spcified energy rating is not exceeded.

IC(AV)max

The maximum permissible average value of the total collector current

I<sub>CM</sub> The maximum permissible instantaneous value of the total collector current.

Emitter current ratings

I<sub>Emax</sub> The maximum permissible emitter current. Without further qualification, the

d.c. value is implied.

The maximum permissible average value of the total emitter current.

IER(AV)max

The maximum permissible average value of the total emitter current when

operating in the reverse emitter-base breakdown region.

The maximum permissible instantaneous value of the total emitter current.

The maximum permissible instantaneous value of the total reverse emitter

current allowable in the reverse breakdown region.

#### Base current ratings

IBmax The maximum permissible base current. Without further qualification, the d.c.

value is implied.

IB(AV)max

The maximum permissible average value of the total base current.

IBR(AV)max

The maximum permissible average value of the total reverse base current allow-

able in the reverse breakdown region.

IBM The maximum permissible instantaneous value of the total base current. The

rating also includes the switch off current.

IBRM The maximum permissible instantaneous value of the total reverse current

allowable in the reverse breakdown region.

#### Transistor power ratings

P<sub>tot</sub> max: The total maximum permissible continuous power dissipation in the transistor and includes both the collector-base dissipation and the emitter-base dissipation. Under steady state conditions the total power is given by the expression:

In order to distinguish between "steady state" and "pulse" conditions the terms "steady state power (PS)" and "pulse power (PP)" are often used. The permissible total power dissipation is dependent upon temperature and its relationship is shown by means of a chart as shown in Fig. 3.

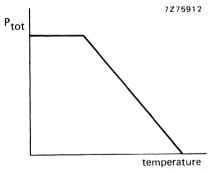


Fig. 3.

The temperature may be ambient, case or mounting base temperatures. Where a cooling clip or a heatsink is attached to the device, the allowable power dissipation is also dependent on the efficiency of the heatsink.

The efficiency of this clip or heatsink is measured in terms of its thermal resistance ( $R_{th\ h}$ ) normally expressed in degrees kelvin per watt (K/W). For mounting base rated devices, the added effect of the contact resistance ( $R_{th\ i}$ ) must be taken into account.

The effect of heatsinks of various thermal resistance and contact resistance is often included in the above chart.

## TRANSISTOR RATINGS

Thus for any heatsink of known thermal resistance and any given ambient temperature, the maximum permissible power dissipation can be established. Alternatively, knowing the power dissipation which will occur and the ambient temperature, the necessary heatsink thermal resistance can be calculated.

A general expression from which the total permissible steady state power dissipation can be calculated is:

$$P_{tot} = \frac{T_j - T_{amb}}{R_{th i-a}}$$

where  $R_{th\;j-a}$  is the thermal resistance from the transistor junction to the ambient. For case rated or mounting base rated devices, the thermal resistance  $R_{th\;j-a}$  is made up of the thermal resistance junction to case or mounting base ( $R_{th\;j-mb}$ ), the contact thermal resistance ( $R_{th\;i}$ ) and the heatsink thermal resistance  $R_{th\;h}$ .

For the calculation of pulse power operation P<sub>p</sub>, the maximum pulse power is obtained by the aid of a chart as shown in Fig. 4.

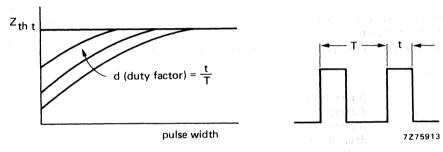


Fig. 4.

The general expression from which the maximum pulse power dissipation can be calculated is:

$$P_{p} = \frac{T_{j} - T_{amb} - P_{s} \times R_{th j-a}}{Z_{th t} + d (R_{th c-a})}$$

where  $Z_{th\,t}$  and d are given in the above chart and  $R_{th\,c-a}$  is the thermal resistance between case and ambient for case rated device. For mounting base rated device, it is equal to  $R_{th\,h} + R_{th\,i}$  and is zero for free air rated device because the effect of the temperature rise of the case over the ambient for a pulse train is already included in  $Z_{th\,t}$ .

#### Temperature ratings

T <sub>jmax</sub>	The maximum permissible junction temperature which is used as the basis f the calculation of power ratings. Unless otherwise stated, the continuous va- is implied.				
T <sub>jmax</sub> (continous operation)	The maximum permissible continuous value.				

T<sub>jmax</sub> (intermittent operation)

The maximum permissible instantaneous junction temperature usually allowed for a total duration of 200 hours.

The temperature of the surface making contact with a heatsink. This is confined to devices where a flange or stud for fixing onto a heatsink forms an integral part of the envelope.

The temperature of the envelope. This is confined to devices to which may be attached a clip-on cooling fin.

T<sub>mb</sub>

Tcase

## LETTER SYMBOLS FOR TRANSISTORS AND SIGNAL DIODES

based on IEC Publication 148

#### LETTER SYMBOLS FOR CURRENTS, VOLTAGES AND POWERS

#### **Basic letters**

The basic letters to be used are:

I, i = current
V, v = voltage
P, p = power.

Lower-case basic letters shall be used for the representation of instantaneous values which vary with time.

In all other instances upper-case basic letters shall be used.

#### Subscripts

A, a	Anode terminal
(AV), (av)	Average value
B, b	Base terminal, for MOS devices: Substrate
(BR)	Breakdown
C, c	Collector terminal
D, d	Drain terminal
E, e	Emitter terminal
F, f	Forward
G, g	Gate terminal
K, k	Cathode terminal
M, m	Peak value
0,0	As third subscript: The terminal not mentioned is open circuited
R, r	As first subscript: Reverse. As second subscript: Repetitive.
	As third subscript: With a specified resistance between the terminal
	not mentioned and the reference terminal.
(RMS), (rms)	R. M. S. value
1	As first or second subscript: Source terminal (for FETS only)
S, s {	As second subscript: Non-repetitive (not for FETS)
	As third subscript: Short circuit between the terminal not mentioned
	and the reference terminal
X, x	Specified circuit
Z, z	Replaces R to indicate the actual working voltage, current or power
	of voltage reference and voltage regulator diodes.

Note: No additional subscript is used for d.c. values.

## LETTER SYMBOL

Upper-case subscripts shall be used for the indication of:

a) continuous (d.c.) values (without signal)

Example I<sub>B</sub>

b) instantaneous total values

Example i<sub>B</sub>

c) average total values

Example I<sub>B(AV)</sub>

d) peak total values

Example I<sub>BM</sub>

e) root-mean-square total values

Example I<sub>B(RMS)</sub>

Lower-case subscripts shall be used for the indication of values applying to the varying component alone:

a) instantaneous values

Example ib

b) root-mean-square values

Example Ib(rms)

c) peak values

Example I<sub>bm</sub>

d) average values

Example Ib(av)

Note: If more than one subscript is used, subscript for which both styles exist shall either be all upper-case or all lower-case.

#### Additional rules for subscripts

#### Subscripts for currents

Transistors: If it is necessary to indicate the terminal carrying the current, this should be done by the first subscript (conventional current flow from the external circuit into the terminal is positive).

Examples: I<sub>B</sub>, i<sub>B</sub>, i<sub>b</sub>, I<sub>bm</sub>

Diodes:

To indicate a forward current (conventional current flow into the anode terminal) the subscript F or f should be used; for a reverse current (conventional current flow out of the anode terminal) the subscript R or r should be used.

Examples: IF, IR, iF, If(rms)

### Subscripts for voltages

Transistors: If it is necessary to indicate the points between which a voltage is meas-

ured, this should be done by the first two subscripts. The first subscript indicates the terminal at which the voltage is measured and the second the reference terminal or the circuit node. Where there is no possibility of confusion the second subscript may be said.

confusion, the second subscript may be omitted.

Examples: 
$$V_{BE}$$
,  $v_{BE}$ ,  $v_{be}$ ,  $V_{bem}$ 

Diodes:

To indicate a forward voltage (anode positive with respect to cathode), the subscript F or f should be used; for a reverse voltage (anode negative with respect to cathode) the subscript R or r should be used.

Examples: 
$$V_F$$
,  $V_R$ ,  $v_F$ ,  $V_{rm}$ 

## Subscripts for supply voltages or supply currents

Supply voltages or supply currents shall be indicated by repeating the appropriate terminal subscript.

Note: If it is necessary to indicate a reference terminal, this should be done by a third subscript

## Subscripts for devices having more than one terminal of the same kind

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal followed by a number; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: I<sub>B2</sub> = continuous (d.c.) current flowing into the second base terminal

V<sub>B2-E</sub> = continuous (d.c.) voltage between the terminals of second base and emitter

## Subscripts for multiple devices

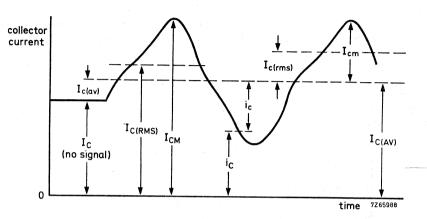
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: I<sub>2C</sub> = continuous (d.c.) current flowing into the collector terminal of the second unit

V<sub>1C-2C</sub> = continuous (d.c.) voltage between the collector terminals of the first and the second unit.

#### Application of the rules

The figure below represents a transistor collector current as a function of time. It consists of a continuous (d.c.) current and a varying component.



## LETTER SYMBOLS FOR ELECTRICAL PARAMETERE METERS

#### Defenition

For the purpose of this Publication, the term "electrical parameter" applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

#### Basic letters

The following is a list of the most important basic letters used for electrical parameters of semiconductor devices.

B, b = susceptance; imaginary part of an admittance

C = capacitance

G, g = conductance; real part of an admittance

H, h = hybrid parameter

L = inductance

R, r = resistance; real part of an impedance

X, x = reactance; imaginary part of an impedance

Y, y = admittance;

Z, z = impedance;

Upper-case letters shall be used for the representation of:

- a) electrical parameters of external circuits and of circuits in which the device forms only a part;
- b) all inductances and capacitances.

Lower-case letters shall be used for the representation of electrical parameters inherent in the device (with the exception of inductances and capacitances).

#### Subscripts

#### General subscripts

The following is a list of the most important general subscripts used for electrical parameters of semiconductor devices:

```
\begin{array}{lll} F,\,f &=& \text{forward; forward transfer} \\ l,\,i\;(\text{or 1}) &=& \text{input} \\ L,\,l &=& \text{load} \\ O,\,o\;(\text{or 2}) &=& \text{output} \\ R,\,r &=& \text{reverse; reverse transfer} \\ S,\,s &=& \text{source} \\ \\ Examples: & Z_S, & h_f, & h_F \end{array}
```

The upper-case variant of a subscript shall be used for the designation of static (d.c.) values.

```
Examples: h_{FE} = \frac{1}{100} static value of forward current transfer ratio in common-emitter configuration (d.c. current gain)
R_{E} = \frac{1}{100} d.c. value of the external emitter resistance.
```

Note: The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

The lower-case variant of a subscript shall be used for the designation of small-signal values.

Examples: 
$$h_{fe}$$
 = small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration 
$$Z_{e} = R_{e} + jX_{e} = small-signal value of the external impedance$$

Note: If more than one subscript is used, subscripts for which both styles exist shall either be all upper-case or all lower-case

## LETTER SYMBOLS

#### Subscripts for four-pole matrix parameters

The first letter subscript (or double numeric subscript) indicates input, output, forward transfer or reverse transfer

Examples: 
$$h_{i}$$
 (or  $h_{11}$ )  
 $h_{i}^{i}$  (or  $h_{22}$ )  
 $h_{f}^{o}$  (or  $h_{21}$ )  
 $h_{r}^{i}$  (or  $h_{12}$ )

A further subscript is used for the identification of the circuit configuration. When no confusion is possible, this further subscript may be omitted.

Examples: 
$$h_{fe}$$
 (or  $h_{21e}$ ),  $h_{FE}$  (or  $h_{21E}$ )

#### Distinction between real and imaginary parts

If it is necessary to distinguish between real and imaginary parts of electrical parameters, no additional subscripts should be used. If basic symbols for the real and imaginary parts exist, these may be used.

Examples: 
$$Z_i = R_i + jX_i$$
  
 $y_{fe} = g_{fe} + jb_{fe}$ 

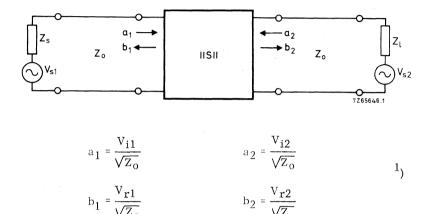
If such symbols do not exist or if they are not suitable, the following notation shall be used:

Examples: Re 
$$(h_{ib})$$
 etc. for the real part of  $h_{ib}$ 

Im  $(h_{ib})$  etc. for the imaginary part of  $h_{ib}$ 

### SCATTERING PARAMETERS

In distinction to the conventional h, y and z-parameters, s-parameters relate to travelling wave conditions. The figure below shows a two-port network with the incident and reflected waves  $a_1$ ,  $b_1$ ,  $a_2$  and  $b_2$ .



 $\mathbf{Z}_{_{\mathrm{O}}}$  = characteristic impedance of the transmission line in which the two-port is connected.

Vi = incident voltage

 $V_r$  = reflected (generated) voltage

The four-pole equations for s-parameters are:

$$b_1 = s_{11}a_1 + s_{12}a_2$$
  
 $b_2 = s_{21}a_1 + s_{22}a_2$ 

Using the subscripts i for 11, r for 12, f for 21 and o for 22, it follows that:

$$s_{i} = s_{11} = \frac{b_{1}}{a_{1}} \Big|_{a_{2}} = 0$$

$$s_{r} = s_{12} = \frac{b_{1}}{a_{2}} \Big|_{a_{1}} = 0$$

$$s_{f} = s_{21} = \frac{b_{2}}{a_{1}} \Big|_{a_{2}} = 0$$

$$s_{o} = s_{22} = \frac{b_{2}}{a_{2}} \Big|_{a_{1}} = 0$$

<sup>1)</sup> The squares of these quantities have the dimension of power.

## S-PARAMETERS

The s-parameters can be named and expressed as follows:

- $s_i$  =  $s_{11}$  = Input reflection coefficient. The complex ratio of the reflected wave and the incident wave at the input, under the conditions  $Z_1$  =  $Z_0$  = 50  $\Omega$  and  $V_{s2}$  = 0.
- $s_r = s_{12}$  = Reverse transmission coefficient. The complex ratio of the generated wave at the input and the incident wave at the output, under the conditions  $Z_s = Z_0 = 50 \Omega$  and  $V_{s1} = 0$ .
- $s_f$  =  $s_{21}$  = Forward transmission coefficient. The complex ratio of the generated wave at the output and the incident wave at the input, under the conditions  $z_l$  =  $z_o$  = 50  $\Omega$  and  $v_{s2}$  = 0.
- $s_o$  =  $s_{22}$  = Output reflection coefficient. The complex ratio of the reflected wave and the incident wave at the output, under the conditions  $Z_s$  =  $Z_o$  = 50  $\Omega$  and  $V_{s1}$  = 0.

DEVICE DATA



## DEVELOPMENT DATA

This data sheet contains advance information and specifications are subject to change without notice.

## BAND-SWITCHING DIODES FOR SURFACE MOUNTING

Switching diodes in a SOD-80 envelope, intended for band switching in v.h.f. television tuners. A special feature of these diodes is their low capacitance.

These SM diodes are leadless diodes in an hermetically sealed micro-miniature glass envelope with tin plated metal discs at each end. They are suitable for Automatic Placement and as such they can withstand immersion soldering.

The diodes are delivered in "super 8" tape.

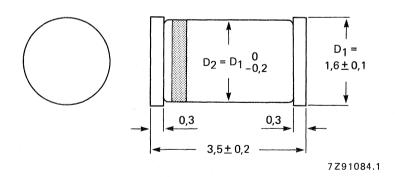
#### QUICK REFERENCE DATA

			BA682	BA683	
Continuous reverse voltage	$V_{R}$	max.	35	35	V
Forward current (d.c.)	١٤	max.	100	100	mA
Junction temperature	$T_{i}$	max.	150	150	оС
Diode capacitance V <sub>R</sub> = 3 V; f = 1 MHz	Сd	<	1,25	1,2	pF
Series resistance at $f = 200 \text{ MHz}$ $I_F = 3 \text{ mA}$ $I_F = 10 \text{ mA}$	r <sub>D</sub>	< <	0,7 0,5	1,2 0,9	$\Omega$

#### **MECHANICAL DATA**

Fig. 1 SOD-80.

Dimensions in mm



The cathode is indicated by a red band.

The BA683 cathode has an additional orange band.

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance with the AL	Solute Ma	ixiiiluiii	System	(160 134)		
Continuous reverse voltage		$v_R$	max.		35	. V
Forward current (d.c.)		1 <sub>F</sub>	max.		100	mA
Storage temperature		$T_{stg}$		-65 to	+150	oC
Junction temperature		Tj			150	oC
THERMAL RESISTANCE						
From junction to ambient in free air		R <sub>th j</sub>	a =		0,6	K/mW
CHARACTERISTICS						
T <sub>j</sub> = 25 °C unless otherwise specified.						
Forward voltage I <sub>F</sub> = 100 mA		V <sub>F</sub>	<		1,0	V
Reverse current $V_R = 20 V$ $V_R = 20 V; T_{amb} = 75 °C$		I <sub>R</sub>	< < <		50 1	nΑ μΑ
				BA682	BA683	
Diode capacitance at f = 1 MHz				-		
V <sub>R</sub> = 1 V		$c_d$	<	1,5	1,5	pF
V <sub>R</sub> = 3 V		-u	<	1,25	1,2	pF
Series resistance at f = 200 MHz					1	

r<sub>D</sub> < 0,7 < 0,5

Ω

I<sub>F</sub> = 3 mA I<sub>F</sub> = 10 mA

## SILICON PLANAR EPITAXIAL HIGH-SPEED DIODE

Silicon epitaxial high-speed diode in a microminiature plastic envelope. It is intended for high-speed switching in hybrid thick and thin-film circuits.

#### QUICK REFERENCE DATA

Continuous reverse voltage	٧ <sub>R</sub>	max.	75 V
Repetitive peak reverse voltage	$V_{RRM}$	max.	85 V
Repetitive peak forward current	IFRM	max.	250 mA
Junction temperature	Τį	max.	175 °C
Forward voltage at I <sub>F</sub> = 50 mA	V <sub>F</sub>	<	1,0 V
Reverse recovery time when switched from $I_F = 10 \text{ mA}$ to $I_R = 10 \text{ mA}$ ; $R_L = 100 \Omega$ ;		,	,
measured at I <sub>R</sub> = 1 mA	<sup>t</sup> rr	<	6 ns
Recovery charge when switched from $I_F = 10 \text{ mA}$ to $V_R = 5 \text{ V}$ ; $R_L = 500 \Omega$	$Q_{S}$	<	45 pC

#### **MECHANICAL DATA** Dimensions in mm Marking code Fig. 1 SOT-23. BAS16 = A63,0 2,8 В 1,9 0,150 0,090 0,95 = 0,2 M A B Α 0,1 max 10° max 2,5 máx ₹ 10° ₩ max 3 \_1,1 max ф 0,1(M) A 30° 7266908.9

TOP VIEW

See also Soldering recommendations.

		and the second s	t work community of the first o	MINISTER MANAGE	NAME OF THE OWNER, OWNER, OWNE
	RATINGS				
	Limiting values in accordance with the Absolute Maximum System (IE	C 134)			
	Continuous reverse voltage	$V_{R}$	max.	75	V
	Repetitive peak reverse voltage	$V_{RRM}$	max.	85	V
	Average rectified forward current <sup>♠</sup> (averaged over any 20 ms period) up to T <sub>amb</sub> = 25 °C**	I <sub>F(AV)</sub>	max.	250	mΑ
	Forward current (d.c.)	۱۴	max.	250	mA
	Repetitive peak froward current	IFRM	max.	250	mA
	Non-repetitive peak forward current (per crystal) $t = 1 \mu s$ $t = 1 ms$ $t = 1 s$	FSM FSM	max. max. max.		A A
		FSM	-65 to		
	Storage temperature range	T <sub>stg</sub>			
	Junction temperature	$T_{j}$	max.	175	°C
	THERMAL RESISTANCE*				
-	From junction to ambient**	R <sub>th j-a</sub>	MARY MARY	430	K/W
	CHARACTERISTICS				
	T <sub>i</sub> = 25 °C unless otherwise specified.				
	Forward voltage  I <sub>F</sub> = 1 mA  I <sub>F</sub> = 10 mA  I <sub>F</sub> = 50 mA  I <sub>F</sub> = 150 mA	VF VF VF	< < < < < < < < < < < < < < < < < < <	715 855 1000 1250	mV mV
	Reverse current $V_R = 25 \text{ V}; T_j = 150 \text{ °C}$ $V_R = 75 \text{ V}$ $V_R = 75 \text{ V}; T_i = 150 \text{ °C}$	IR IR IR		1	μΑ μΑ μΑ
	Diode capacitance VR = 0; f = 1 MHz	$c_d$	<	2	pF
	Forward recovery voltage (see also Fig. 2) when switched to $I_F = 10 \text{ mA}$ ; $t_p = 20 \text{ ns}$	V <sub>fr</sub>	1	1,75	V
	Reverse recovery time (see also Fig. 3) when switched from I <sub>F</sub> = 10 mA to I <sub>R</sub> = 10 mA; B <sub>1</sub> = 100 O; measured at I <sub>D</sub> = 1 mA	ter		6	ns

45 pC

 $R_L = 100 \Omega$ ; measured at  $I_R = 1 \text{ mA}$ 

when switched from  $I_F = 10 \text{ mA}$  to  $V_R = 5 \text{ V}$ ;

Recovery charge (see also Fig. 4)

 $R_L = 500 \Omega$ 

<sup>^</sup> Measured under pulse conditions.  $t_p \le 0.5$  ms.  $I_{F(AV)} = 150$  mA,  $t_{(aV)} \le 1$  ms, for sinusoidal operation.

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

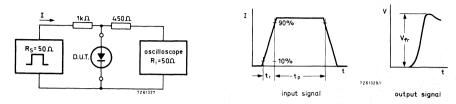


Fig. 2 Forward recovery voltage test circuit and waveforms.

forward pulse rise time =  $t_r$  = 20 ns; forward current pulse duration  $t_p$  = 120 ns; duty Input signal:

factor =  $\delta$  = 0,01.

Oscilloscope: rise time =  $t_r = 0.35$  ns.

Circuit capacitance  $C \le 1$  pF (C = oscilloscope input capacitance + parasitic capacitance).

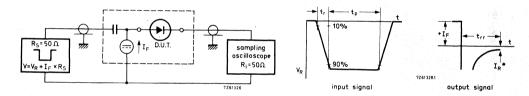


Fig. 3 Reverse recovery time test circuit and waveforms.

reverse pulse rise time =  $t_r$  = 0,6 ns; reverse pulse duration =  $t_p$  = 100 ns; duty Input signal:

factor =  $\delta$  = 0,05. \*  $t_{rr}$  up to  $l_R = 1$  mA.

Oscilloscope: rise time =  $t_r = 0.35$  ns.

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance).

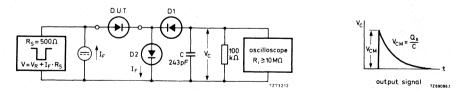


Fig. 4 Recovery charge test circuit and waveform.

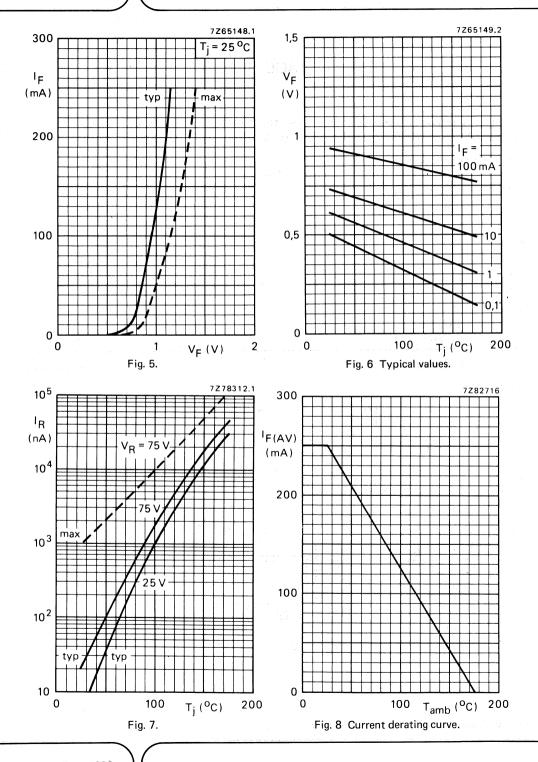
D1 = BAW62; D2 = diode with minority carrier life time at 10 mA:  $\leq$  200 ps Input signal

Rise time of the reverse pulse

Reverse pulse duration

400 ns Duty factor 0,02 Circuit capacitance C ≤ 7 pF (C = oscilloscope input capacitance + parasitic capacitance).

2 ns



## LOW VOLTAGE STABISTOR

Silicon planar epitaxial diode in SOT-23 envelope. This diode is intended for low voltage stabilizing e.g. bias stabilizer in class-B output stages, clipping, clamping and meter protection.

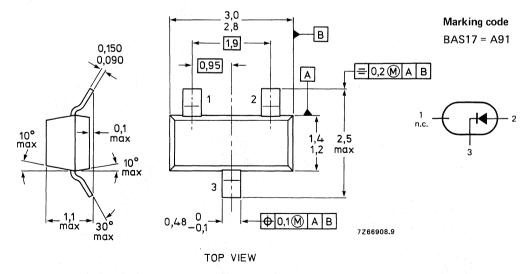
#### QUICK REFERENCE DATA

Repetitive peak forward current	IFRM	max. 250 n	nΑ
Storage temperature	T <sub>stg</sub>	-65 to + 150 °C	C
Junction temperature	Tj	max. 175 <sup>c</sup>	C
Forward voltage			
$I_F = 0.1 \text{ mA}$	٧ <sub>F</sub>	580 to 660 n	nV
I <sub>F</sub> = 1,0 mA	$V_{F}$	665 to 745 n	nV
I <sub>F</sub> = 10 mA	٧ <sub>F</sub>	750 to 830 n	nV
I <sub>F</sub> = 100 mA	٧ <sub>F</sub>	870 to 960 n	nV
Diode capacitance			
V <sub>R</sub> = 0; f = 1 MHz	c <sub>d</sub>	< 140 p	)F

#### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm



See also chapter Soldering Recommendations.

#### **RATINGS**

Repetitive peak forward current **	IFRM	max. 250 mA
Storage temperature	T <sub>stg</sub>	-65 to + 150 °C
Junction temperature	Tj	max. 175 <sup>O</sup> C
THERMAL CHARACTERISTICS*		
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$		
Thermal resistance		
From junction to tab	R <sub>th j-t</sub>	= 60 K/W
From tab to soldering points	R <sub>th t-s</sub>	= 280 K/W
From soldering points to ambient**	R <sub>th s-a</sub>	= 90 K/W
CHARACTERISTICS		
T <sub>i</sub> = 25 °C unless otherwise specified		
Forward voltage		
$I_F = 0.1 \text{ mA}$	V <sub>F</sub>	580 to 660 mV

Limiting values in accordance with the Absolute Maximum System (IEC 134)

I<sub>F</sub> = 10 mA I<sub>F</sub> = 100 mA

 $I_F = 1.0 \text{ mA}$ 

 $I_F = 5.0 \text{ mA}$ 

Reverse current  $V_R = 4 V$ 

Temperature coefficient  $I_F = 1 \text{ mA}$  Diode capacitance

 $V_R = 0$ ; f = 1 MHz

< 5 μA

٧F

٧F

٧F

٧F

IR

665 to 745 mV

725 to 805 mV

750 to 830 mV

870 to 960 mV

 $S_F$  typ. -1,8 mV/K

C<sub>d</sub> < 140 pF

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 7 mm  $\times$  5 mm  $\times$  0,5 mm.

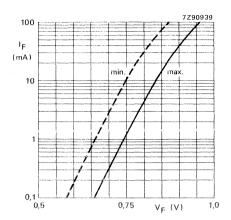


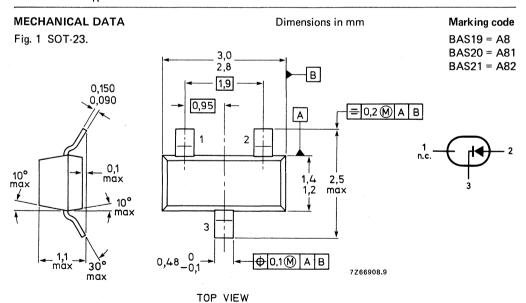
Fig. 2 Forward current as a function of forward voltage.

# SILICON PLANAR EPITAXIAL HIGH-SPEED DIODES

Silicon epitaxial high-speed diodes in a microminiature plastic envelope. They are intended for switching and general purposes.

#### QUICK REFERENCE DATA

			BAS19	BAS20	BAS2	1
Continuous reverse voltage	$v_R$	max.	100	150	200	V
Repetitive peak reverse voltage	$v_{RRM}$	max.	120	200	250	٧
Repetitive peak forward current	IFRM	max.		625		mΑ
Junction temperature	Τį	max.		150		$^{\rm oC}$
Forward voltage at I <sub>F</sub> = 100 mA	٧F	<		1		٧
Reverse recovery time when switched from I <sub>F</sub> = 30 mA to I <sub>R</sub> = 30 mA; R <sub>L</sub> = 100 $\Omega$ measured at I <sub>R</sub> = 3 mA	t <sub>rr</sub>	<		50		ns



See also Soldering recommendations.

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

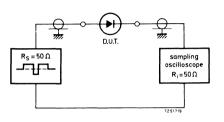
Limiting values in accordance with the Absolute iv	iaximum S	ystem	(IEC 13	54)		
			3AS19	BAS20	BAS21	ern.
Continuous reverse voltage	$V_{R}$	max.	100	150	200	٧
Repetitive peak reverse voltage	$V_{RRM}$	max.	120	200	250	V
 Non-repetitive peak forward current (per crystal)			**************************************	enconstantining of the second	an an an an an an an an an an an an an a	
t = 1 μs t = 1 s	IFSM IFSM	max. max.		2,5 0,5		A
Average rectified forward current (1) (averaged over any 20 ms period)	lF(AV)	max.		200		mA
Forward current (d.c.) up to T <sub>amb</sub> = 25 °C**	lF	max.		200		mA
Repetitive peak forward current	IFRM	max.		625		mΑ
Storage temperature range	T <sub>stg</sub>			-65  to + 1	150	$^{\rm oC}$
Junction temperature	Ti	max.		150		$^{\rm oC}$
Total power dissipation up to $T_{amb} = 25$ °C	P <sub>tot</sub>	max.		200		mW
THERMAL RESISTANCE*						
From junction to ambient**	R <sub>th j-a</sub>			(ATRIAL SATISM	430	K/W
From tab to soldering points	R <sub>th t-s</sub>			=	280	K/W
From soldering points to ambient**	$R_{ths-a}$			ntine Manual	90	K/W
CHARACTERISTICS						
T <sub>j</sub> = 25 °C unless otherwise specified.						
Forward voltage						
I <sub>F</sub> = 100 mA	٧F			< <	1,0	V
I <sub>F</sub> = 200 mA	٧F			<	1,25	V
Reverse breakdown voltage (1) BAS19; I <sub>R</sub> = 100 μA	V(BR)R			> > >	120	٧
BAS20; $I_R = 100 \mu A$ BAS21; $I_R = 100 \mu A$ (2)	V(BR)R V(BR)R			>	200 250	V V
Reverse current	· (DII)N			•		•
$V_R = V_{Rmax}$ $V_R = V_{Rmax}$ ; $T_i = 150 ^{\circ}\text{C}$	I <sub>R</sub> I <sub>R</sub>			< <	100 100	nΑ μΑ
Differential resistance	·n			•	4	****
I <sub>F</sub> = 10 mA	<sup>r</sup> diff			typ.	5	Ω

<sup>(1)</sup> Measured under pulse conditions; Pulse time =  $t_p \le 0.3$  ms. (2) At zero life time, measured under pulse conditions to avoid excessive dissipation and voltage limited to 275 V.

See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Diode capacitance  $V_R = 0; \ f = 1 \ \text{MHz} \qquad C_d \qquad < \qquad 5 \ \text{pF}$  Reverse recovery time (see Figs 2 and 3) when switched from IF = 30 mA to IR = 30 mA;  $R_L = 100 \ \Omega; \ \text{measured at IR} = 3 \ \text{mA} \qquad t_{rr} \qquad < \qquad 50 \ \text{ns}$ 



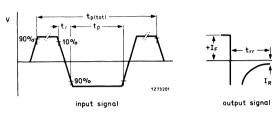


Fig. 2 Test circuit.

Fig. 3 Waveforms;  $I_R = 3 \text{ mA}$ .

In	put signal		
	total pulse duration	tp(tot)	= $2 \mu s$ = $0,0025$
	duty factor	δ	= 0,0025
	rise time of reverse pulse	t <sub>r</sub>	= 0,6 ns
	reverse pulse duration	tp	= 100 ns
0	scilloscope		
	rise time	t <sub>r</sub>	= 0,35 ns
	circuit capacitance*	Ċ	< 1 pF

<sup>\*</sup>C = oscilloscope input capacitance + parasitic capacitance.

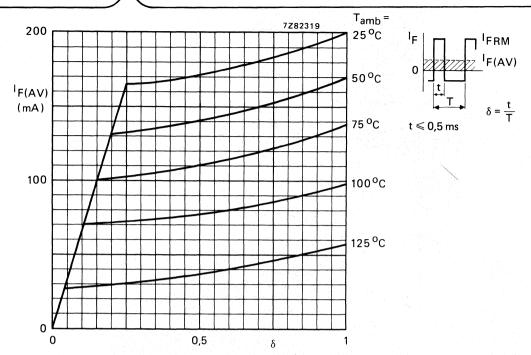


Fig. 4 BAS19; maximum permissible average rectified forward current for pulse operation as a function of the duty factor at  $V_R = 100 \text{ V}$ .

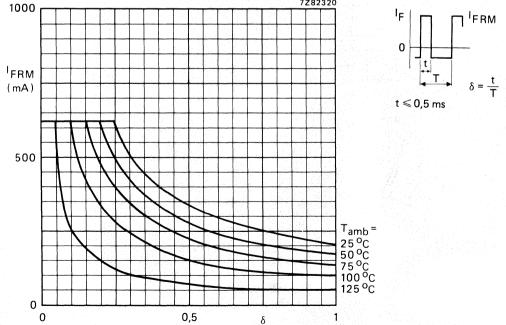


Fig. 5 BAS19; maximum permissible repetitive peak forward current for pulse operation as a function of the duty factor at  $V_R = 100 \text{ V}$ .

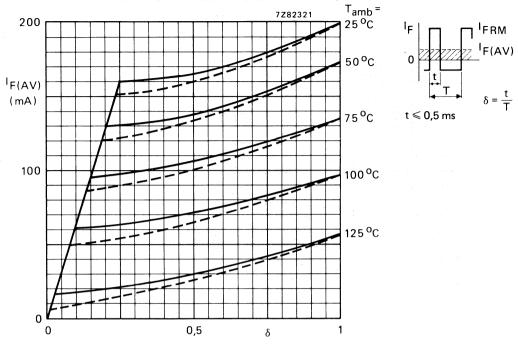


Fig. 6 BAS20/21; maximum permissible average rectified forward current for pulse operation as a function of the duty factor.

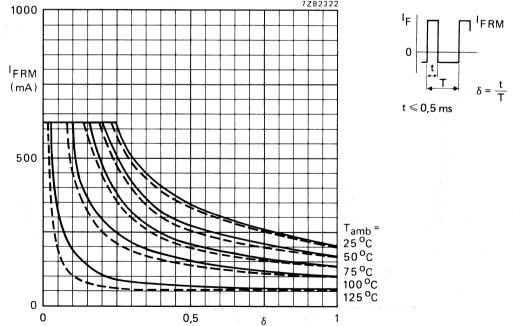


Fig. 7 BAS20/21; maximum permissible repetitive peak forward current for pulse operation as a function of the duty factor.

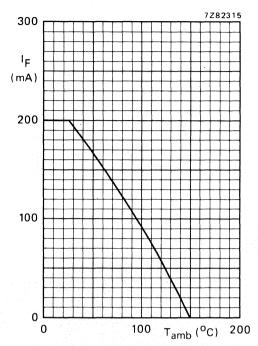
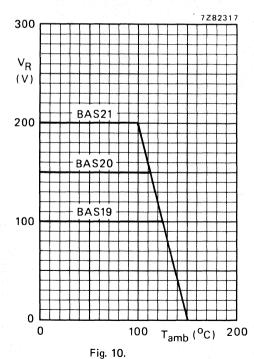


Fig. 8.



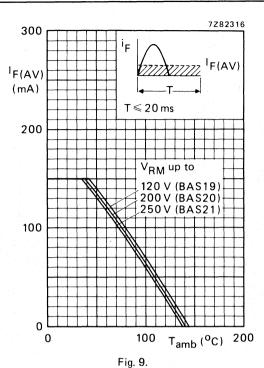
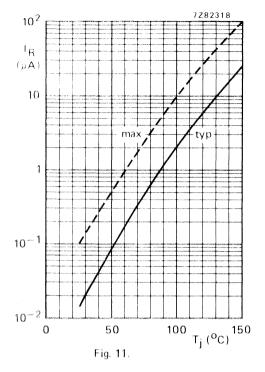


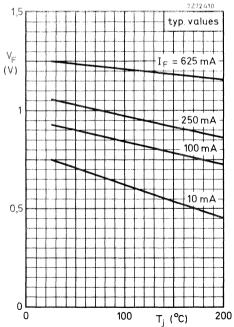
Fig. 8 Maximum permissible continuous forward current as a function of the

ambient temperature.

Fig. 9 Maximum permissible average rectified forward current as a function of the ambient temperature.

Fig. 10 Maximum permissible continuous reverse voltage as a function of the ambient temperature.





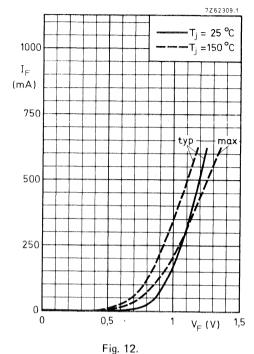


Fig. 11 Continuous reverse current as a function of the junction temperature.

Fig. 12 Forward current as a function of forward voltage.

Fig. 13 Forward voltage as a function of the junction temperature.

Fig. 13.

BAS19 BAS20 BAS21

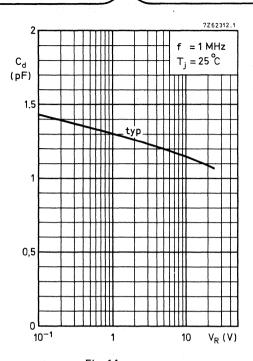


Fig. 14.

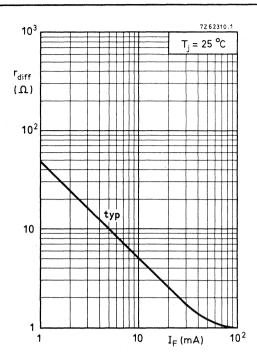


Fig. 15.

# SILICON PLANAR EPITAXIAL HIGH-SPEED DIODE

The BAS28 consists of two separate diodes in one microminiature envelope intended for surface mounting.

It concerns fast-switching general-purpose diodes.

#### **QUICK REFERENCE DATA**

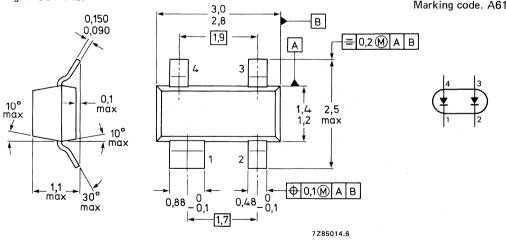
Continuous reverse voltage	٧ <sub>R</sub>	max.	75	V
Repetitive peak reverse voltage	$V_{RRM}$	max.	85	V
Repetitive peak forward current	IFRM	max.	250	mΑ
Junction temperature	$T_{j}$	max.	175	оС
Forward voltage at I <sub>F</sub> = 50 mA	٧ <sub>F</sub>	<	1,0	V
Reverse recovery time when switched from I $_{F}$ = 10 mA to I $_{R}$ = 10 mA; R $_{L}$ = 100 $\Omega$ , measured at I $_{R}$ = 1 mA	t <sub>rr</sub>	. •	6	ns
Recovery charge when switched from $I_F = 10 \text{ mA}$ to $V_R = 5 \text{ V}$ ; $R_L = 500 \Omega$	O <sub>s</sub>	<	45	рC

#### **MECHANICAL DATA**

Fig. 1 SOT-143.

Dimensions in mm

Marking code. A61



TOP VIEW

Limiting values in accordance with the Al	bsolute Maxin	num System (IE	C 134)			
Continuous reverse voltage			$v_R$	max.	75	V
Repetitive peak reverse voltage			$v_{RRM}$	max.	85	V
Average rectified forward current (averaged over any 20 ms period) up to T <sub>amb</sub> = 25 °C**			IF(AV)	max.	250	mA
Forward current (d.c.)			l <sub>E</sub>	max.	250	mA
Repetitive peak forward current			FRM	max.	250	mΑ
Non-repetitive peak forward current (per crystal)						
$t = 1 \mu s$			FSM	max.		A
t = 1 ms t = 1 s			FSM	max. max.	0,5	Α Δ
Storage temperature range			FSM T <sub>stq</sub>	-65 to 4		
Junction temperature			'stg T <sub>i</sub>	max.	175	
			.)			_
THERMAL RESISTANCE*						
From junction to ambient			R <sub>th j-a</sub>	e compression de la compressio	430	K/W
CHARACTERISTICS						
T <sub>j</sub> = 25 °C unless otherwise specified						
Forward voltage						
I <sub>F</sub> = 1 mA			VF.	5		mV mV
I <sub>F</sub> = 10 mA I <sub>F</sub> = 50 mA			V <sub>F</sub> V <sub>E</sub>	<	1000	
I <sub>F</sub> = 150 mA			V <sub>F</sub>	<	1250	
Reverse current			i i Tili i tili. Tili i tili			
$V_R = 25 \text{ V}; T_j = 150 ^{\circ}\text{C}$			l <sub>R</sub>	< '		$\mu$ A
V <sub>R</sub> = 75 V			I <sub>R</sub>	· < <		μA μA
$V_R = 75 \text{ V}; T_j = 150 ^{\circ}\text{C}$			<sup>I</sup> R		50	μH
Diode capacitance V <sub>R</sub> = 0; f = 1 MHz			cd	1<	2	рF
Forward recovery voltage (see also Fig. 2			Vr	< 1	1,75	\/
when switched to $I_F = 10$ mA; $t_p = 20$ Reverse recovery time (see also Fig. 3)	1113		Vfr		1,53	¥
when switched from $I_F = 10 \text{ mA to } I_R$ $R_L = 100 \Omega$ ; measured at $I_R = 1 \text{ mA}$	= 10 mA;		t <sub>rr</sub>	<	6	ns
Recovery charge (see also Fig. 4)			* *			
when switched from I <sub>F</sub> = 10 mA to V <sub>I</sub> R <sub>L</sub> = 500 $\Omega$	R = 5 V;		$\Omega_{S}$	<	45	рС

<sup>^</sup> Measured under pulse conditions.  $t_p \le 0.5$  ms.  $I_{F(AF)} = 150$  mA,  $t_{(av)} \le 1$  ms, for sinusoidal operation.

<sup>\*</sup> See Thermal characteristics.
\*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

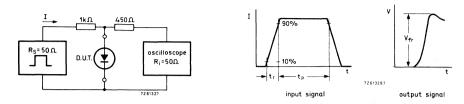


Fig. 2 Forward recovery voltage test circuit and waveforms.

forward pulse rise time =  $t_r$  = 20 ns; forward current pulse duration  $t_p$  = 120 ns; duty Input signal:

factor =  $\delta$  = 0,01.

Oscilloscope: rise time =  $t_r = 0.35$  ns.

Circuit capacitance  $C \le 1$  pF (C = oscilloscope input capacitance + parasitic capacitance).

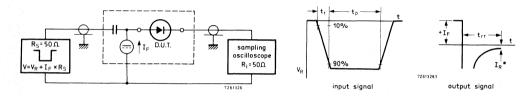


Fig. 3 Reverse recovery time test circuit and waveforms.

Input signal:

reverse pulse rise time =  $t_r$  = 0,6 ns; reverse pulse duration =  $t_p$  = 100 ns; duty factor =  $\delta$  = 0,05. \*  $t_{rr}$  up to  $l_R$  = 1 mA.

rise time =  $t_r = 0.35$  ns. Oscilloscope:

Circuit capacitance  $C \le 1$  pF (C = oscilloscope input capacitance + parasitic capacitance).

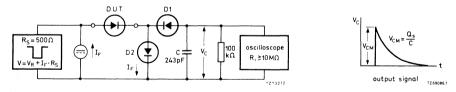


Fig. 4 Recovery charge test circuit and waveform.

D1 = BAW62; D2 = diode with minority carrier life time at 10 mA: < 200 ps Input signal

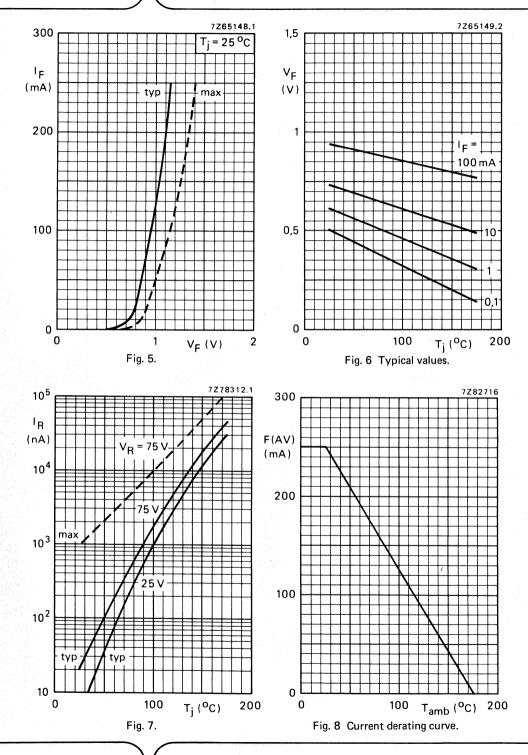
Rise time of the reverse pulse

Reverse pulse duration

Duty factor

2 ns 400 ns 0,02

Circuit capacitance C ≤ 7 pF (C = oscilloscope input capacitance + parasitic capacitance).



# SILICON PLANAR EPITAXIAL HIGH-SPEED DIODES

The BAS29, BAS31 and the BAS35 are silicon planar epitaxial diodes encapsulated in a SOT-23 envelope.

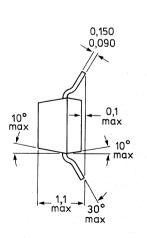
The BAS29 consists of a single diode. The BAS31 has two diodes in series and the BAS35 has two diodes with a common anode. All diodes are designed for switching inductive loads in semi-electronic telephone exchanges.

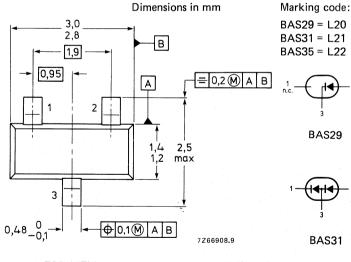
### QUICK REFERENCE DATA (per diode)

Continuous reverse voltage	$v_R$	max.	90 V
Repetitive peak forward current	<sup>I</sup> FRM	max.	600 mA
Forward current	lF.	max.	250 mA
Junction temperature	Τį	max.	150 °C
Forward voltage at I <sub>F</sub> = 50 mA	ν̈́F	<	0,84 V
Reverse recovery time when switched from IF = 30 mA to IR = 30 mA; RL = 100 $\Omega$ ;			
measured at I <sub>R</sub> = 3 mA	t <sub>rr</sub>	<	50 ns

#### **MECHANICAL DATA**

Fig. 1 SOT-23.





TOP VIEW



BAS31

BAS29

BAS35

# RATINGS (per diode)

Limiting values in accordance with the Absolute Maximum System (IEC	C 134)			
Continuous reverse voltage	$V_{R}$	max.	90	V
Repetitive peak forward current	IFRM	max.	600	mA
Repetitive peak reverse current	IRRM	max.	600	mΑ
Average rectified forward current (averaged over any 20 ms period)	1F	max.	250	
Non-repetitive peak forward current $t = 1 \mu s$ ; $T_j = 25  ^{O}C$ prior to surge; per crystal $t = 1 s$ ; $T_j = 25  ^{O}C$ prior to surge; per crystal	<sup>I</sup> FSM	max.	3 0,75	A A
Forward current (d.c.)	lF	max.	250	mΑ
Repetitive peak reverse energy				
$tp \le 50 \text{ s}; f \le 20 \text{ Hz}; T_j = 25 ^{0}\text{C}$	ERRM	€	5,0	mJ
Storage temperature	T <sub>stq</sub>	-65 to -	175	оС
Junction temperature	Tj	max.	150	оС
THERMAL RESISTANCE				
From junction to ambient when mounted on ceramic substrate of 7 mm $\times$ 5 mm $\times$ 0,5 mm	R <sub>th j-a</sub>	= -	430	K/W
CHARACTERISTICS (per diode)				
T <sub>i</sub> = 25 <sup>0</sup> C unless otherwise specified				
Forward voltage				
I <sub>F</sub> = 10 mA	٧F	€	0,75	٧
I <sub>F</sub> = 50 mA	٧F	$\leq$	0,84	٧
I <sub>F</sub> = 100 mA	٧F	$\leq$	0,90	٧
$I_F = 200 \text{ mA}$	VF	€	1,00	٧
$I_F = 400 \text{ mA}$	٧F	$\leq$	1,25	V
Reverse current V <sub>R</sub> = 90 V		<b>\left\</b>	100	nA
V <sub>R</sub> = 90 V; T <sub>j</sub> = 150 °C	<sup>I</sup> R		100	
Reverse avalanche breakdown voltage				
I <sub>R</sub> = 1 mA A	V <sub>(BR)R</sub>	120 to	175	V
Diode capacitance V <sub>R</sub> = 0; f = 1 MHz	$C_d$	€	35	pF

t<sub>rr</sub>

50 ns

Reverse recovery time when switched from I  $_F$  = 30 mA to I  $_R$  = 30 mA; R  $_L$  = 100  $\Omega;$  measured at I  $_R$  = 3 mA

# HIGH-SPEED SILICON DIODE FOR SURFACE MOUNTING

The BAS32 is a planar epitaxial high-speed diode designed for fast logic applications.

This SM diode is a leadless diode in a hermetically sealed SOD-80 envelope with tin-plated metal discs at each end. It is suitable for "automatic placement" and as such it can withstand immersion soldering. The diodes are delivered in "super 8" tape.

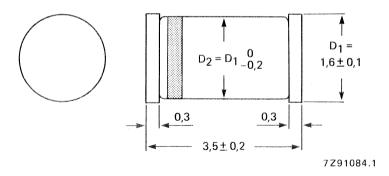
#### QUICK REFERENCE DATA

Continuous reverse voltage	VR	max.	75 V
Repetitive peak reverse voltage	$v_{RRM}$	max.	75 V
Repetitive peak forward current	<sup>I</sup> FRM	max.	450 mA
Junction temperature	$T_{\hat{J}}$	max.	200 °C
Forward voltage IF = 100 mA	٧ <sub>F</sub>	<	1 V
Reverse recovery time when switched from IF = 10 mA to IR = 10 mA; RL = 100 $\Omega$ ; measured at IR = 1 mA	t <sub>rr</sub>	<	4 ns

#### **MECHANICAL DATA**

Fig. 1 SOD-80.

Dimensions in mm



Cathode indicated by black band.

#### **RATINGS**

HATINGS					
Limiting values in accordance with the Absolute Maximum System	(IEC 134)				
Continuous reverse voltage	$v_R$	max.	75	٧	
Repetitive peak reverse voltage	$V_{RRM}$	max.	75	V*	
Average rectified forward current	<sup>I</sup> F(AV)	max.	150	mA**	
Forward current (d.c.)	I <sub>F</sub>	max.	200	mA	
Repetitive peak forward current	IFRM	max.	450	mΑ	
Non-repetitive peak forward current					
$t = 1 \mu s$	IFSM	max.	2000		
t = 1 s	IFSM	rnax.	500	mA	
Storage temperature	T <sub>stg</sub>	-65 to	+ 200	οС	
Junction temperature	$T_{j}$	max.	200	oC	
THERMAL RESISTANCE					
	р	<u> 1</u> 777 il	0.6	K/mW	
From junction to ambient in free air	R <sub>th j-a</sub>	, <sup>7</sup> , 0,5 s	0,0	K/IIIVV	
CHARACTERISTICS					
T <sub>j</sub> = 25 °C unless otherwise specified					
Forward voltages					
$I_F = 5 \text{ mA}$	$V_{F}$	0,62 to	•		
I <sub>F</sub> = 100 mA	٧F	<	1,00		
$I_F = 100 \text{ mA}; T_j = 100 ^{\circ}\text{C}$	VF	<	0,93	V	
Reverse currents VR = 20 V			25	nA	
V <sub>R</sub> = 20 V V <sub>R</sub> = 20 V; T <sub>i</sub> = 150 °C	I <sub>R</sub>	2		μA	
V <sub>R</sub> = 75 V	'R IR	<		μA	
V <sub>R</sub> = 75 V; T <sub>i</sub> = 150 °C	I <sub>R</sub>	<	100		
Diode capacitance					
$V_R = 0$ ; $f = 1 MHz$	Cd	<	2	pF	
Forward recovery voltage when switched to					
$I_F = 50 \text{ mA}$ ; $t_r = 20 \text{ ns}$	$V_{fr}$	<	2.5	V	

<sup>\*</sup> Measured at zero life time at I  $_R$  = 100  $\mu\text{A}$ ; V  $_R$  > 100 V. \*\* For sinusoidal operation see Fig. 6. For pulse operation see Figs 4 and 5.

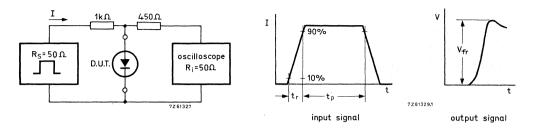


Fig. 2 Forward recovery voltage test circuit and waveforms.

Input signal: Rise time of the forward pulse

Forward current pulse duration

 $t_r = 20 \text{ ns}$  $t_p = 120 \text{ ns}$  $\delta = 0.01$ 

**Duty factor** 

 $t_r = 0.35 \text{ ns}$ 

Oscilloscope: Rise time

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Reverse recovery time when switched from

 $I_F = 10 \text{ mA} \text{ to } I_R = 10 \text{ mA}; R_1 = 100 \Omega;$ 

measured at IR = 1 mA

4 ns

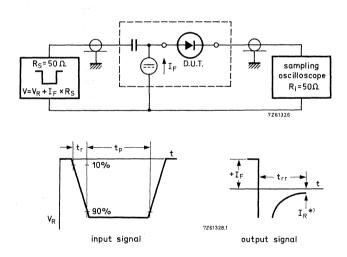


Fig. 3 Reverse recovery time test circuit and waveforms.

Input signal: Rise time of the reverse pulse

 $t_r = 0.6 \text{ ns}$ 

\* IR = 1 mA

Reverse pulse duration

 $t_p = 100 \text{ ns}$  $\delta = 0.05$ 

**Duty factor** 

Oscilloscope: Rise time

 $t_r = 0.35 \text{ ns}$ 

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

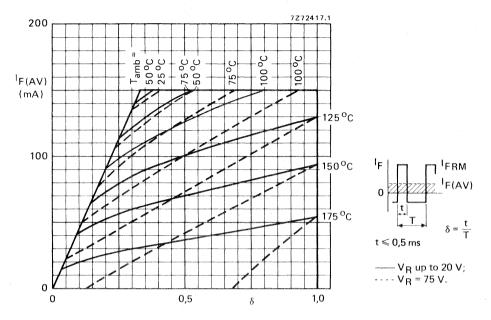


Fig. 4 Maximum permissible average rectified forward current versus duty factor (pulse operated).

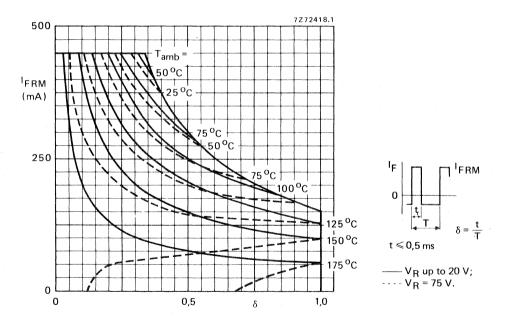


Fig. 5 Maximum permissible repetitive peak forward current versus duty factor (pulse operated).

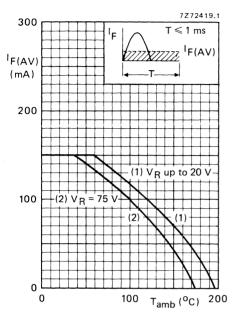


Fig. 6 Maximum permissible average rectified forward current versus ambient temperature.

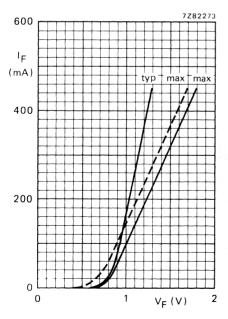


Fig. 8 Forward current versus forward voltage;  $T_j = 25 \, {}^{\circ}\text{C}; --- T_j = 175 \, {}^{\circ}\text{C}.$ 

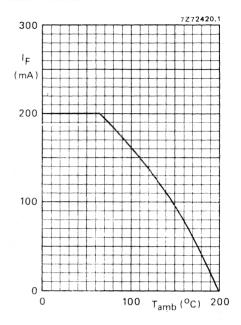


Fig. 7 Maximum permissible continuous forward current versus ambient temperature.

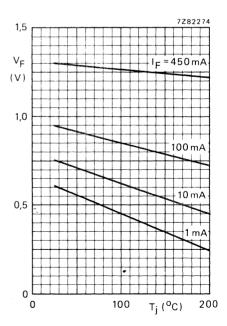


Fig. 9 Forward voltage versus junction temperature; typical values.

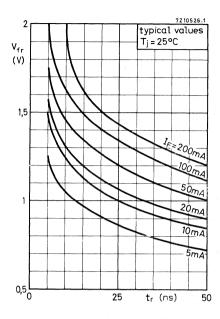


Fig. 10 Forward recovery voltage versus rise time.

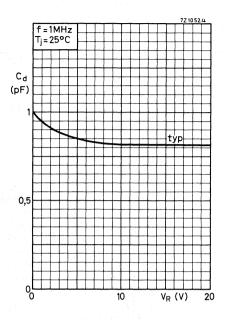


Fig. 11 Diode capacitance versus reverse voltage.

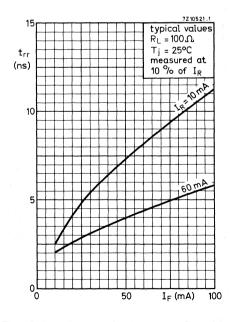


Fig. 12 Reverse recovery time versus forward current.

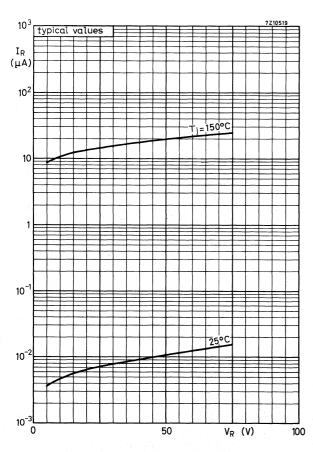


Fig. 13 Reverse current versus reverse voltage.

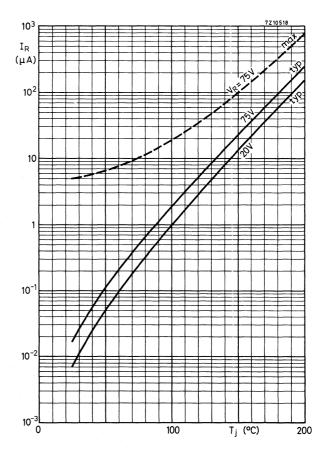


Fig. 14 Reverse current versus junction temperature.

		1949 I

# SILICON PLANAR EPITAXIAL ULTRA-HIGH SPEED DIODE

The BAS56 consists of two separate planar epitaxial ultra-liigh speed, high conductance diodes in one microministure plastic envelope intended for surface mounting.

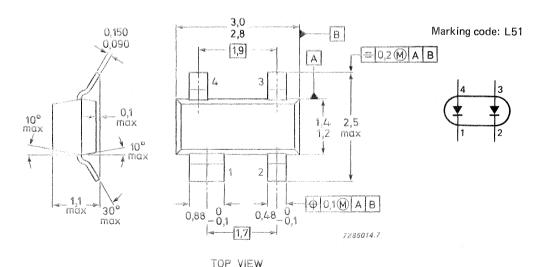
The device is primarily intended for core gating in very fast memories using the Surface Mounted Devices (SMD) technology.

#### QUICK REFERENCE DATA

			single diode	series connection	
Continuous reverse voltage	$v_R$	max.	60	120	V
Repetitive peak reverse voltage	$v_{RRM}$	max.	60	120	V
Forward current	IF	max.	200	150	mA
Repetitive peak forward current	IFRM	max.	600	430	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	300		mW
Reverse recovery time when switched from Tp = 400 mA to Tp = 400 mA; RL = 100 $\Omega$ ; measured at Tp = 40 mA	t <sub>rr</sub>	<	6		ns

#### MECHANICAL DATA Fig. 1 SOT-143.

Dimensions in mm



July 1987

## **RATINGS**

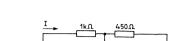
Limiting values in accordance with the Absolute Maximum System (IEC 134)

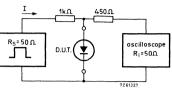
				single diode	series conne	ection	
	Continuous reverse voltage	v <sub>R</sub>	max.	60	120	V	
	Repetitive peak reverse voltage*	$V_{RRM}$	max.	60	120	V	
	Forward current	ΙĘ	max.	200	150	mA	
	Repetitive peak forward current	IFRM	max.	600	430	mA	
-	Non-repetitive peak forward current (per crystal)						
	$t = 1 \mu s$	<sup>I</sup> FSM	max.	20	000	mΑ	
	t = 1 s	IFSM	max.	. 5	000	mA	
	Total power dissipation** up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	3	00	mW	
	Storage temperature range	T <sub>stq</sub>		-65 to	+150	ρС	
	Junction temperature	Tj	max.	1	50	oC	
	THERMAL RESISTANCE						
	From junction to ambient**	R <sub>th j-a</sub>	=	4	30	K/W	
	CHARACTERISTICS, per diode						
	T <sub>i</sub> = 25 <sup>o</sup> C unless otherwise specified						
	Forward voltage						
	$I_F = 10 \text{ mA}$	VF	<	0,		V	
	I <sub>F</sub> = 200 mA	VF	< <	1,0		V	
	I <sub>F</sub> = 200 mA; T <sub>j</sub> = 100 °C I <sub>F</sub> = 500 mA	V <sub>F</sub>	<	0,9		V	
	<b>.</b>	٧F		۱,،	20	V	
	Reverse current V <sub>R</sub> = 60 V	IR	<	10	n .	nA	
	V <sub>R</sub> = 60 V; T <sub>i</sub> = 150 °C	I <sub>R</sub>	<	10		μΑ	
	Diode capacitance	••					
	$V_R = 0$ ; f = 1 MHz	$c_d$	<	2,5	5	pF	

<sup>\*</sup> Measured at zero life time at I  $_R$  = 10  $\mu$ A; V  $_R$  = 75 V. \*\* Mounted on a ceramic substrate of 10 mm x 8 mm x 0,6 mm.

Forward recovery voltage when switched to

$$I_F = 400 \text{ mA}; t_r 1 = 30 \text{ ns}$$
  
 $I_F = 400 \text{ mA}; t_r 2 = 100 \text{ ns}$ 







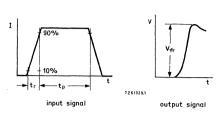


Fig. 2 Test circuit and waveforms; forward recovery voltage.

Input signal: 1st rise time of the forward pulse 
$$t_r 1 = 30$$
 ns 2nd rise time of the forward pulse  $t_r 2 = 100$  ns Forward current pulse duration  $t_p = 300$  ns Duty factor  $\delta = 0,01$ 

Oscilloscope: Rise time  $t_r = 0.35$  ns

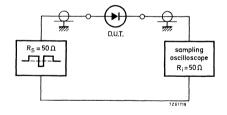
Input capacitance Circuit capacitance  $C \le 20 \text{ pF}$  ( $C = C_i + \text{parasitic capacitance}$ )

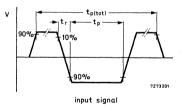
Reverse recovery time when switched

from 
$$I_F = 400 \text{ mA}$$
 to  $I_R = 400 \text{ mA}$ ;

$$R_L = 100 \Omega$$
; measured at  $I_R = 40 \text{ mA}$ 

< 6 trr ns







ρF

Fig. 3 Test circuits and waveforms; reverse recovery time.

 $*I_{R} = 40 \text{ mA}$ 

Input signal:	Total pulse duration	<sup>t</sup> p(tot)	=	0,2	μs
	Duty factor	δ	=	0,0025	
•	Rise time of the reverse pulse	t <sub>r</sub>	=	0,6	ns
	Reverse pulse duration	tp	=	30	ns
Oscilloscope:	Rise time	t <sub>r</sub>	=	0,35	ns

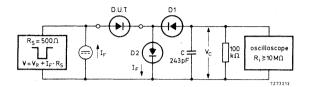
Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Recovery charge when switched from  $I_F$  = 10 mA to  $V_R$  = 5 V;  $R_L$  = 500  $\Omega$ 

 $Q_{s}$ 

50

рC



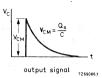


Fig. 4 Test circuit and waveform; recovery charge.

Circuit capacitance C ≤ 7 pF (C = oscilloscope input capacitance + parasitic capacitance)

# SCHOTTKY BARRIER DIODE

Silicon epitaxial diode in a microminiature plastic envelope. Intended for u.h.f. mixer and fast switching applications in thick and thin-film circuits.

#### QUICK REFERENCE DATA

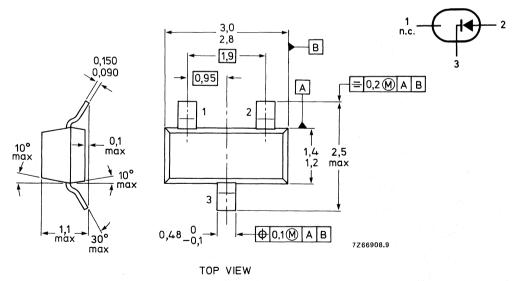
Continuous reverse voltage	V <sub>R</sub> max. 4 V
Forward current (d.c.)	I <sub>F</sub> max. 30 mA
Junction temperature	T <sub>i</sub> max. 100 °C
Forward voltage at I <sub>F</sub> = 10 mA	V <sub>F</sub> < 600 mV
Diode capacitance at $V_R = 0$ ; $f = 1 MHz$	$C_d$ < 1,0 pF
Noise figure at f = 900 MHz	F < 8,0 dB

#### MECHANICAL DATA

Dimensions in mm

Marking code BAT17 = A3

Fig.1 SOT-23.



See also Soldering recommendations.

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance w	ith the Absolute Maximum System	(IEC 134)			
Continuous reverse voltage		٧R	max.	4	٧
Forward current (d.c.) **		I <sub>F</sub>	max.	30	mΑ
Storage temperature		T <sub>stg</sub>	-65 to	+100	οС
Junction temperature		Тj	max.	100	оС
THERMAL RESISTANCE*					
From junction to ambient**		R <sub>th j-a</sub>	=	430	K/W
CHARACTERISTICS					
T <sub>amb</sub> = 25 °C unless otherwise s	specified				
Reverse current V <sub>R</sub> = 3 V		I <sub>R</sub>	<	0,25	μΑ
$V_R = 3 V; T_{amb} = 60  {}^{\circ}C$		IR	<	1,25	μΑ
Reverse breakdown voltage $I_R = 10 \mu A$		V <sub>(BR)R</sub>	>	4	٧
Forward voltage					
$I_F = 0.1 \text{ mA}$		$\mathbf{v}_{F}$	<	350	mV
I <sub>F</sub> = 1,0 mA		V <sub>F</sub>	<	450	mV
I <sub>F</sub> = 10 mA		٧ <sub>F</sub>	<	600	mV
Diode capacitance V <sub>R</sub> = 0; f = 1 MHz		c <sub>d</sub>	<	1,0	пF
Noise figure at f = 900 MHz ▲		F	<	8,0	
Series resistance at f = 1 kHz		•		0,0	<b>4 5</b>
I <sub>E</sub> = 5 mA		rD	<	15	Ω

See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

The local oscillator is adjusted for a diode current of 2 mA. I.F. amplifier noise F<sub>if</sub> = 1,5 dB; f = 35 MHz.

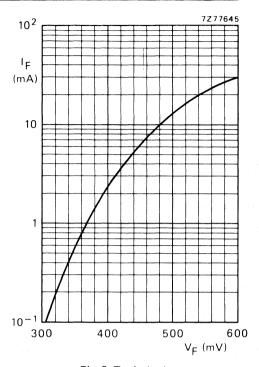


Fig. 2 Typical values.

# SILICON PLANAR DIODE

Band switching diode in a microminiature plastic envelope. Intended for thick and thin-film circuits.

#### QUICK REFERENCE DATA

VR	max.	35 V
۱F	max.	100 mA
Тj	max.	100 °C
C <sub>d</sub>	typ.	0,8 pF 1,0 pF
r <sub>D</sub>	typ.	0,5 Ω 0,7 Ω
	IF T <sub>j</sub>	IF max.

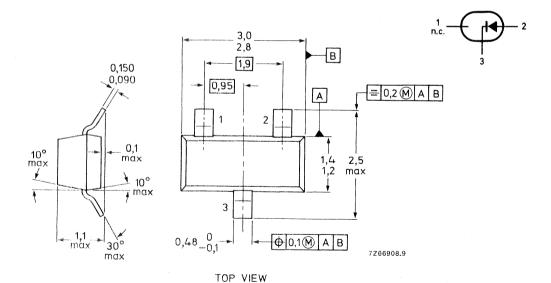
MECHANICAL DATA

Fig. 1 SOT-23.

Dimensions in mm

Marking code

BAT18 = A2



# **BAT18**

## **RATINGS**

Continuous reverse voltage		$v_R$	max.	35 V
Forward current (d.c.)		l <sub>F</sub>	max.	100 mA
Storage temperature		T <sub>stg</sub>	-55 to +	125 °C
Junction temperature		Tj	max.	125 °C
THERMAL DECLOTANOES				

Limiting values in accordance with the Absolute Maximum System (IEC 134)

#### THERMAL RESISTANCE

Reverse current

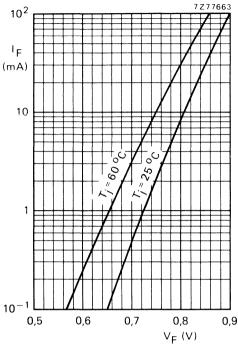
THE THE STATE OF T	
From junction to ambient**	$R_{th j-a} = 430 \text{ K/W}$
CHARACTERISTICS	
T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified	
Forward voltage at I <sub>F</sub> = 100 mA	V <sub>F</sub> < 1,2 V

$V_R = 20 V$	I <sub>R</sub>	<	100 nA
$V_R = 20 \text{ V}; T_j = 60 \text{ °C}$	I <sub>R</sub>	<	1 μΑ
Diode capacitance at f = 1 MHz			00 5

$V_R = 20 V$		Cd	typ. <	0,8 pF 1,0 pF
Series resistance at f = 200 MHz				
I <sub>F</sub> = 5 mA	· .	rD	typ.	0,5 Ω

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.



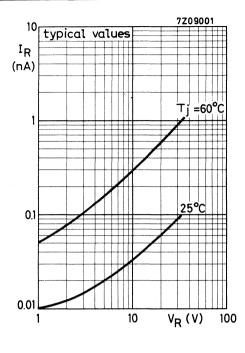
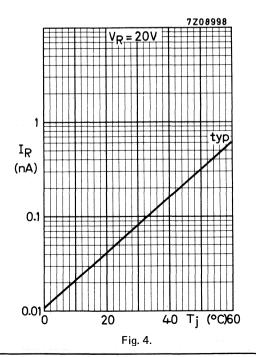
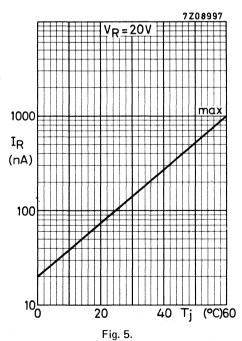


Fig. 2 Typical values.







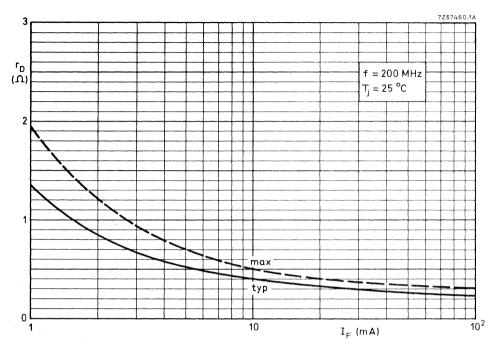


Fig. 6.

This data sheet contains advance information and specifications are subject to change without notice.

# SCHOTTKY BARRIER DIODE

Silicon epitaxial Schottky barrier diode with an integrated p-n junction protection ring in a microminiature SOT-23 envelope intended for surface mounting.

The diode features especially a low forward voltage.

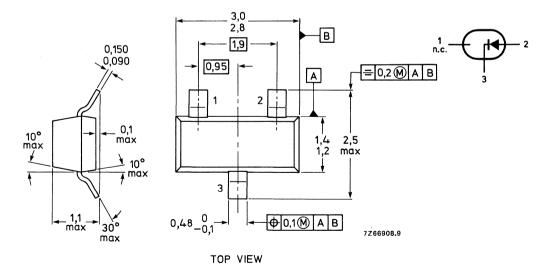
#### **QUICK REFERENCE DATA**

Continuous reverse voltage	٧ <sub>R</sub>	max.	30	V	
Forward current (d.c.)	Ιϝ	max.	200	mA	
Forward voltage at $I_F = 10 \text{ mA}$	VF	max.	400	mV	
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	230	mW	
Reverse recovery time when switched from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100 \Omega$ ; measured at $I_R = 1$ mA	t <sub>rr</sub>	<b>\leq</b>	5	ns	
Junction temperature	Tj	max.	125	оС	

Fig. 1 SOT-23

Dimensions in mm

Marking code: L4



Continuous reverse voltage	VR	max.	30	V
Forward current (d.c.) see Fig. 2	l⊨	max.	200	mΑ
Repetitive peak forward current	IFRM	max.	300	mA
Non-repetitive peak forward current				
t < 1 s	<sup>I</sup> FSM	max.	600	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	230	mW
Storage temperature	$T_{stq}$	<b>–55</b>	to +150	oC
Junction temperature	Тј	max.	125	оС
THERMAL RESISTANCE				
From junction to ambient mounted on a ceramic				
substrate of 10 mm x 8 mm x 0,6 mm	R <sub>th j-a</sub>		430	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Forward voltage				
$I_F = 0.1 \text{ mA}$	V <sub>F</sub>	€	240	mV
$I_F = 1 \text{ mA*}$	V <sub>F</sub>	$\leq$	320	mV
$I_{F} = 10 \text{ mA}$	V <sub>F</sub>	<	400	mV
$I_F = 30 \text{ mA*}$	V <sub>F</sub>	$\leq$	500	mV
I <sub>F</sub> = 100 mA	V <sub>F</sub>	=	500	mV
	٧F	$\epsilon < \epsilon$	1000	mV
Reverse current				
$V_R = 25 V$	I <sub>R</sub>	$\leq$	2	μΑ
Reverse breakdown voltage	V <sub>(BR)F</sub>	>	30	V
Diode capacitance				
$V_R = 1 V$ ; $f = 1 MHz$	$c_d$	$\leq$	10	pF
Reverse recovery time when switched from				
$I_F = 10 \text{ mA to } I_R = 10 \text{ mA};$				
$R_L = 100 \Omega$ ; measured at $I_R = 1 \text{ mA}$	t <sub>rr</sub>	$\leq$	5	ns

<sup>\*</sup> Temperature coefficient of forward voltage:

<sup>-0,6 %/</sup>K at I<sub>F</sub> = 1 mA -0,3 %/K at I<sub>F</sub> = 30 mA

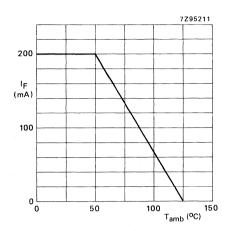
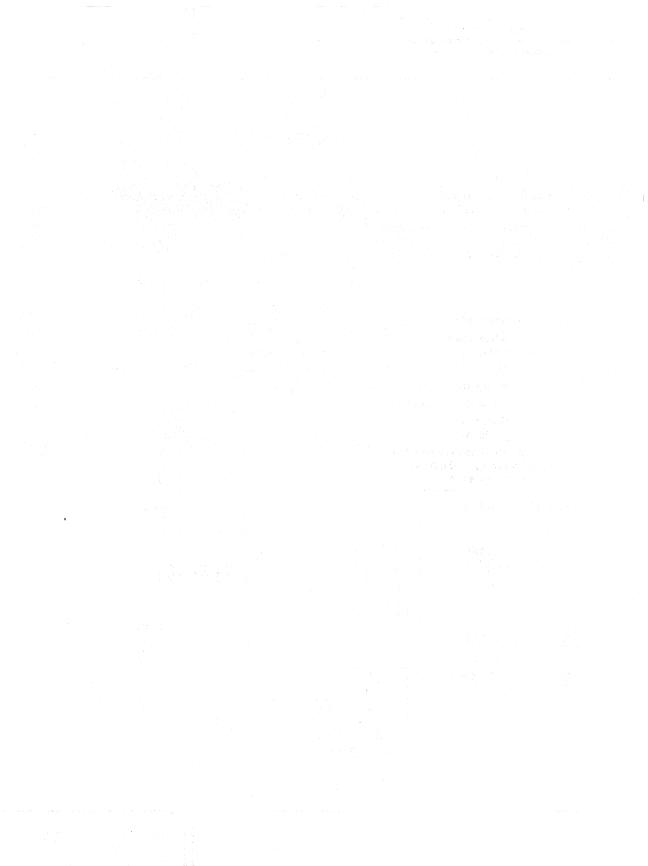


Fig. 2 Derating curve maximum ambient temperature.



This data sheet contains advance information and specifications are subject to change without notice.

## SCHOTTKY BARRIER DIODE

Two separate silicon epitaxial Schottky barrier diodes with an integrated p-n junction protection ring in one microminiature SOT-143 envelope, intended for surface mounting (SMD technology).

The device features a low forward voltage drop.

#### QUICK REFERENCE DATA

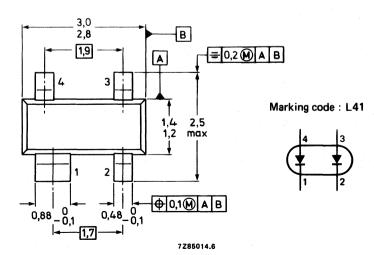
				double-diode operation		
Continuous reverse voltage	$V_{R}$	max.	30	3	0 V	
Continuous reverse voltage series connection	٧ <sub>R</sub>	max.	_	6	0 V	
Forward current	۱F	max.	200	11	0 mA	
Repetitive peak forward current	FRM	max.	300	20	0 mA	
Non-repetitive peak forward current	I <sub>FSM</sub>	max.	6	00	mA	
Total power dissipation up to $T_{amb} = 25$ °C	P <sub>tot</sub>	max.	2	30	mW	
Reverse recovery time when switched from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100$ $\Omega$ ;						
measured at I <sub>R</sub> = 1 mA	t <sub>rr</sub>	<b>\leq</b>		5	ns	

#### **MECHANICAL DATA**

Fig. 1 SOT-143.

Dimensions in mm

0,150 0,090 0,090 0,150 0,090 0,1 max 10° max 10° max



TOP VIEW

**RATINGS** 

			single diode	double-d operatio	
Continuous reverse voltage	V <sub>R</sub>	max.	30	3	80 V
Continuous reverse voltage series connection	V <sub>R</sub>	max.		6	50 V
Forward current (see Fig. 2)	lE.	max.	200		0*mA
Repetitive peak forward current	I <sub>FRM</sub>	max.	300	20	00 mA
Non-repetitive peak forward current $t < 1 s$	IFSM	max.	ε	600	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	2	230	mW
Storage temperature	$T_{stg}$		-65	to + 150	oC
Junction temperature	Тj	max.	1	25	oC
THERMAL RESISTANCE					
From junction to ambient mounted on a ceramic substrate of 10 mm x 8 mm x 0,6 mm	R <sub>th j-a</sub>		4	130	K/W
CHARACTERISTICS, per diode					
T <sub>amb</sub> = 25 °C unless otherwise specified					
Forward voltage  IF = 0,1 mA  IF = 1 mA**  IF = 10 mA  IF = 30 mA**	V <sub>F</sub>	W W W W	3 4	240 320 300 500	mV mV mV
I <sub>F</sub> = 100 mA	VF	=		00	mV
Reverse current V <sub>R</sub> = 25 V	•	<	10	000	mV •
Reverse breakdown voltage	I <sub>R</sub>	<b>≤</b>		2	μΑ
Diode capacitance	V <sub>(BR)R</sub>	>		30	V
$V_R = 1 \text{ V}; f = 1 \text{ MHz}$	Cd	€		10	рF
Reverse recovery time when switched from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100$ $\Omega$ ; measured at $I_R = 1$ mA	t <sub>rr</sub>	€		5	ns
n · · · · ·	711			•	113

<sup>\*</sup> If both diodes are in forward operation at the same moment, total device current max. 110 mA. If one diode is in reverse and the other in forward operation at the same moment, total device current max. 200 mA.

<sup>\*\*</sup> Temperature coefficient of forward voltage: -0.6%/K at  $I_F = 1$  mA.

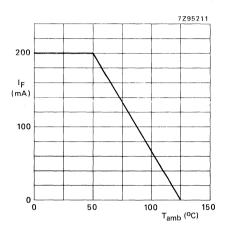


Fig. 2 Derating curve maximum ambient temperature.



This data sheet contains advance information and specifications are subject to change without notice.

## SILICON PLANAR EPITAXIAL HIGH-SPEED DIODE

The BAV23 consists of two separate planar epitaxial high-speed diodes in one microminiature plastic envelope intended for surface mounting.

The device is designed for switching and general applications where high breakdown voltages are required.

#### QUICK REFERENCE DATA

			single diode	series connection
Continuous reverse voltage	$v_{R}$	max.	200	400 V
Repetitive peak reverse voltage	$v_{RRM}$	max.	250	500 V
Average forward current	IF(AV)	max.	200	120 mA
Repetitive peak forward current	<sup>I</sup> FRM	max.	625	450 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	3	300 mW
Reverse recovery time when switched from I $_F$ = 30 mA to I $_R$ = 30 mA; R $_L$ = 100 $\Omega$ ; measured at I $_R$ = 3 mA	t <sub>rr</sub>	<		50 ns

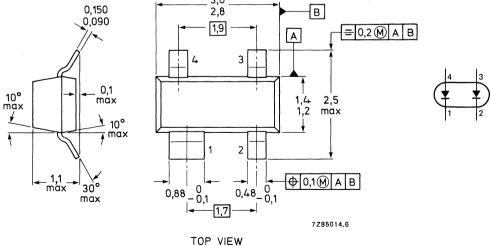
#### **MECHANICAL DATA**

Fig. 1 SOT-143.

Dimensions in mm

Marking code: L30

2,8



Limiting values in accordance with the Absolute wi	axunum System (IL	C 134)		
			single diode	series connection
Continuous reverse voltage	$v_{R}$	max.	200	400 V
Repetitive peak reverse voltage	$V_{RRM}$	max.	250	500 V
Average forward current	I <sub>F(AV)</sub>	max.	200	120 mA
Repetitive peak forward current	<sup>I</sup> FRM	max.	625	450 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	3	' 00 mW
Storage temperature	$T_{stg}$		−65 to	+150 °C
Junction temperature	$T_{j}$	max.	1	50 °C
THERMAL RESISTANCE				
From junction to ambient on a ceramic substrate of 8 mm x 10 mm x 0,6 mm	R <sub>th j-a</sub>		4	30 K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified			single diode	series connection
Forward voltage  I <sub>F</sub> = 100 mA  I <sub>F</sub> = 200 mA	V <sub>F</sub>	< <	1000 1250	2000 mV 2500 mV
Reverse current VR = VRmax	I <sub>R</sub>	<	100	100 nA
Reverse breakdown voltage 1 $I_R = 100 \mu A$	V <sub>(BR)R</sub>	>	250	500 V
Differential forward resistance $I_F = 10 \text{ mA}$	r <sub>f</sub>	typ.	5	10 Ω
Diode capacitance $V_R = 0$ ; $f = 1 MHz$	c <sub>d</sub>	<	5	2,5 pF
Reverse recovery time when switched from I <sub>F</sub> = 30 mA to I <sub>R</sub> = 30 mA;				
$R_L = 100 \Omega$ ; measured at $I_R = 3 \text{ mA}$	t <sub>rr</sub>	<	50	50 ns

## SILICON PLANAR EPITAXIAL HIGH-SPEED DIODES

The BAV70 consists of two diodes in a microminiature plastic envelope. The cathodes are commoned and the unit is intended for high-speed switching in thick and thin-film circuits.

## QUICK REFERENCE DATA (per diode)

Continuous reverse voltage	VR	max.	70 V
Repetitive peak reverse voltage	$V_{RRM}$	max.	70 V
Repetitive peak forward current	l <sub>FRM</sub>	max.	<b>250</b> mA
Junction temperature	Ti	max.	175 °C
Forward voltage at I <sub>F</sub> = 50 mA	V <sub>F</sub>	<	1,0 V
Reverse recovery time when switched from $I_F$ = 10 mA to $I_R$ = 10 mA; $R_L$ = 100 $\Omega$ ; measured at $I_R$ = 1 mA	t <sub>rr</sub>	<	6 ns
Recovery charge when switched from $I_F$ = 10 mA to $V_R$ = 5 V; $R_L$ = 500 $\Omega$	$\Omega_{S}$	<	45 pC

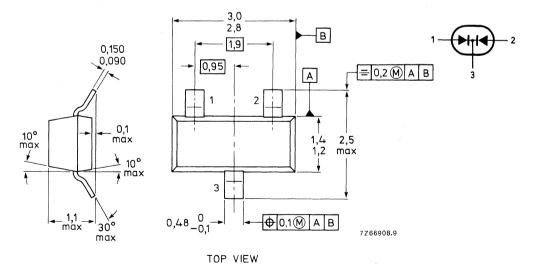
#### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm

Marking code

BAV70 = A4



See also Soldering recommendations.

## RATINGS (per diode)

	Limiting values in accordance with the Absolute Maximum Sy	stem (IEC 13	4)		
	Continuous reverse voltage	$v_R$	max.	70	٧
	Repetitive peak reverse voltage	$v_{RRM}$	max.	70	٧
	Average rectified forward current (averaged over any 20 ms period)	I <sub>F(AV)</sub>	max.	250	mA
	Forward current (d.c.)	IF.	max.	250	mΑ
	Repetitive peak forward current	<sup>I</sup> FRM	max.	250	mΑ
-	Non-repetitive peak forward current (per crystal)				
	$t = 1 \mu s$	IFSM	max.		Α
	t = 1 ms t = 1 s	IFSM	max.		A
		<sup>I</sup> FSM	max.	0,5	
	Storage temperature range	T <sub>stg</sub>	-65 to		-
	Junction temperature	Tj	max.	175	оС
	THERMAL RESISTANCE*		1		
	From junction to ambient**	R <sub>th j-a</sub>	\= \( \)	430	K/W
	CHARACTERISTICS (per diode)				
	T <sub>i</sub> = 25 <sup>o</sup> C unless otherwise specified				
	Forward voltage				
	I <sub>F</sub> = 1 mA	V <sub>F</sub>	<	715	mV
	I <sub>F</sub> = 10 mA	V <sub>F</sub>		855	mV
	I <sub>F</sub> = 50 mA	V <sub>E</sub>	<	1000	mV
	I <sub>F</sub> = 150 mA	v <sub>F</sub>	<	1250	mV
	Reverse current				
	V <sub>R</sub> = 25 V; T <sub>i</sub> = 150 °C	I <sub>R</sub>	<	60	μΑ
	V <sub>R</sub> = 70 V	I <sub>R</sub>	< 1	5	μΑ
	V <sub>R</sub> = 70 V; T <sub>j</sub> = 150 °C	I <sub>R</sub>	<	100	μΑ
	Diode capacitance				
	V <sub>R</sub> = 0; f = 1 MHz	c <sub>d</sub>	<	1,5	pF
	Forward recovery voltage when switched to				
	$I_F = 10 \text{ mA}; t_r = 20 \text{ ns}$	, V <sub>fr</sub> ,	< ,	1,75	<b>V</b>

<sup>▲</sup> Measured under pulse conditions : pulse time  $t_p \le 0.5$  ms. For sinusoidal operation  $I_{F(AV)}$  = 150 mA; averaging time  $t_{(av)} \le 1$  ms.

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup>Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

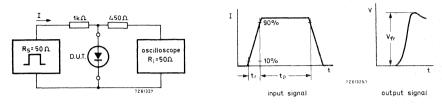


Fig. 2 Test circuit and waveforms; forward recovery voltage.

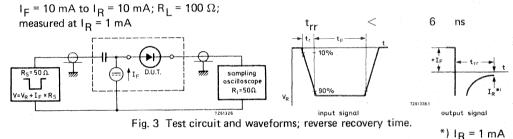
Input signal: Rise time of the forward pulse  $t_r = 20$  ns; Forward current pulse duration  $t_p = 120$  ns;

Duty factor  $\delta = 0.01$ 

Oscilloscope: Rise time  $t_r = 0.35$  ns

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Reverse recovery time when switched from



Input signal: Rise time of the reverse pulse  $t_r = 0.6$  ns; reverse pulse

duration  $t_D = 100$  ns; duty factor  $\delta = 0.05$ 

Oscilloscope : Rise time  $t_r = 0.35$  ns

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Recovery charge when switched from

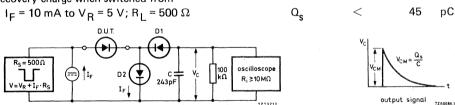


Fig. 4 Test circuit and waveform; recovery charge.

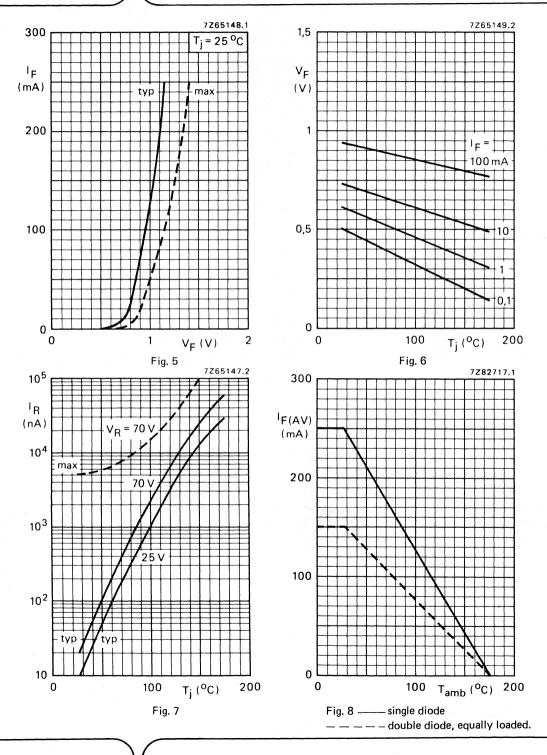
D1 = BAW62

D2 = diode with minority carrier life time at 10 mA: < 200 ps

Input signal : Rise time of the reverse pulse =  $t_r$  = 2 ns; Reverse pulse duration =  $t_p$  = 400 ns;

Duty factor =  $\delta = 0.02$ 

Circuit capacitance C ≤ 7 pF (C = oscilloscope input capacitance + parasitic capacitance)



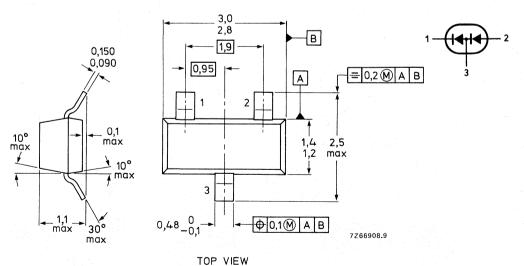
## SILICON PLANAR EPITAXIAL HIGH-SPEED DIODES

The BAV99 consists of two diodes in a microminiature plastic envelope. The diodes are connected in series and the unit is intended for high-speed switching in thick and thin-film circuits.

## QUICK REFERENCE DATA (per diode)

Continuous reverse voltage	$v_{R}$	max.	70 V
Repetitive peak reverse voltage	$v_{RRM}$	max.	70 V
Repetitive peak forward current	I <sub>FRM</sub>	max.	250 mA
Junction temperature		max.	175 °C
Forward voltage at $I_F = 50 \text{ mA}$	$v_{F}$	<	1,0 V
Reverse recovery time when switched from			
$I_F = 10 \text{ mA to } I_R = 10 \text{ mA}; R_L = 100 \Omega;$			
measured at I <sub>R</sub> = 1 mA	t <sub>rr</sub>	<	6 ns
Recovery charge when switched from			
$I_F = 10 \text{ mA to } V_R = 5 \text{ V}; R_L = 500 \Omega$	$Q_{S}$	<	45 pC

## MECHANICAL DATADimensions in mmMarking codeFig. 1 SOT-23.BAV99 = A7



See also Soldering recommendations.

## RATINGS (per diode)

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Continuous reverse voltage  $V_{R}$ 

 $V_{RRM}$ 

Repetitive peak reverse voltage

Average rectified forward current (averaged over any 20 ms period)

Forward current (d.c.)

Repetitive peak forward current

 Non-repetitive peak forward current (per crystal)

 $t = 1 \mu s$ t = 1 mst = 1 s

Storage temperature range

Junction temperature

 $T_i$ 

**IFRM IFRM IFRM** T<sub>stg</sub> max.

R<sub>th i-a</sub>

VF.

٧F

٧Ė

٧E

1<sub>R</sub>

lR

1<sub>R</sub>

 $C^{\mathbf{d}}$ 

 $V_{fr}$ 

IF(AV)

**IFRM** 

1E

max. max. max.  $-65 \text{ to} + 175 \text{ }^{\circ}\text{C}$ 

max.

max.

max.

max.

max.

2 A 1 A

70 V

70 V

250 mA

250 mA

250 mA

0,5 A

175 °C

430 K/W









T<sub>i</sub> = 25 °C unless otherwise specified

Forward voltage

THERMAL RESISTANCE\* From junction to ambient\*\*

 $I_F = 1 \, \text{mA}$ 

 $I_F = 10 \text{ mA}$ 

 $I_F = 50 \text{ mA}$ 

 $I_{\rm F} = 150 \, \rm mA$ 

Reverse current  $V_R = 25 V; T_i = 150 °C$ 

 $V_R = 70 \text{ V}$ 

 $V_R = 70 \text{ V}; T_i = 150 \text{ }^{\circ}\text{C}$ Diode capacitance

 $V_R = 0$ ; f = 1 MHz

Forward recovery voltage when switched to  $I_F = 10 \text{ mA}$ ;  $t_r = 20 \text{ ns}$ 

For sinusoidal operation  $I_{F(AV)} = 150 \text{ mA}$ ; averaging time  $t_{(av)} \le 1 \text{ ms}$ . \* See Thermal characteristics. \*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

^ Measured under pulse conditions: pulse time  $t_p$  ≤ 0,5 ms.

715 mV 855 mV 1000 mV

1250 mV

30 µA

2,5 μΑ

50 μA

1,5 pF

1.75 V

<

<

<

<

<

May 1987

122

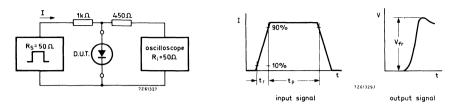


Fig. 2 Test circuit and waveforms; forward recovery voltage.

Input signal: Rise time of the forward pulse  $t_r = 20 \text{ ns}$ ;

Forward current pulse duration =  $t_D$  = 120 ns. Duty factor =  $\delta$  = 0,01.

Oscilloscope: Rise time  $t_r = 0.35$  ns.

Circuit capacitance  $C \le 1$  pF (C = oscilloscope input capacitance + parasitic capacitance).

Reverse recovery time when switched from

$$I_F$$
 = 10 mA to  $I_R$  = 10 mA;  $R_L$  = 100  $\Omega$ ; measured at  $I_R$  = 1 mA

< 6 ns

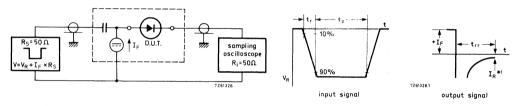


Fig. 3 Test circuit and waveforms; reverse recovery time.

Input signal: Rise time of the reverse pulse  $t_r = 0.6$  ns

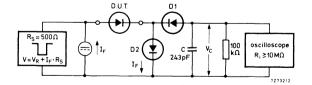
Reverse pulse duration  $t_D = 100$  ns. Duty factor  $\delta = 0.05$ .

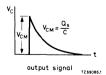
Circuit capacitance  $C \le 1$  pF (C = oscilloscope input capacitance + parasitic capacitance).

Recovery charge when switched from

Oscilloscope: Rise time  $t_r = 0.35$  ns.

$$I_F$$
 = 10 mA to  $V_R$  = 5 V;  $R_L$  = 500  $\Omega$   $Q_S$  < 45 pC





\*)  $I_{R} = 1 \, \text{mA}$ 

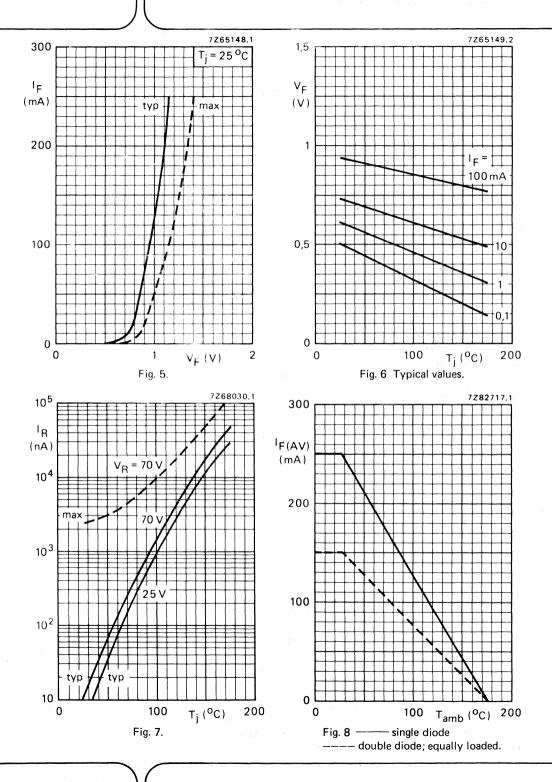
Fig. 4 Test and waveform; recovery charge.

D2 = diode with minority carrier life time at 10 mA: < 200 ps; D1 = BAW62.

Input signal: Rise time of the reverse pulse  $t_r = 2$  ns

Reverse pulse duration  $t_D = 400$  ns. Duty factor  $\delta = 0.02$ .

Circuit capacitance  $C \le 7$  pF (C = oscilloscope input capacitance + parasitic capacitance).



This data sheet contains advance information and specifications are subject to change without notice.

## GENERAL PURPOSE DIODES FOR SURFACE MOUNTING

Silicon planar epitaxial diodes; intended for switching and general purposes in industrial equipment e.g. oscilloscopes, digital voltmeters and video output stages in colour television.

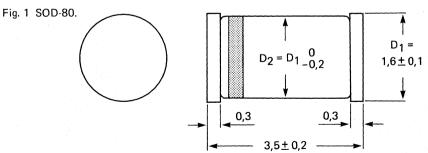
The SM DIODE is a leadless diode in an hermetically sealed glass envelope with tin plated metal discs at each end. It is suitable for Automatic Placement and as such it can withstand immersion soldering. The diodes are delivered in "super 8" tape.

#### QUICK REFERENCE DATA

		BAV	100	BAV101	BAV102	BAV103	
Continuous reverse voltage	$v_R$	max.	50	100	150	200	<b>V</b> , ,
Forward current (d.c.)	l <sub>F</sub>	max.			250		mA
Junction temperature	$T_{j}$	max.			175		oC
Thermal resistance from junction to ambient	R <sub>th j</sub>	a =		0	,375		K/mW
Forward voltage at I <sub>F</sub> = 100 mA	VF	<			1,0		V
Reverse current at $V_R = V_{Rmax}$	IR	<			100		nA
Diode capacitance at $V_R = 0$ ; $f = 1$ MHz	c <sub>d</sub>	typ.			1,5 5,0		pF pF
Reverse recovery time when switched from $I_F = 30$ mA to $I_R = 30$ mA; $I_R = 100 \Omega$ ; measured at $I_R = 3$ mA	t <sub>rr</sub>	<			50		ns
The root sty mountained at the original	11	•					

#### **MECHANICAL DATA**

Dimensions in mm



The BAV100 cathode is indicated by a green and a black band.

The BAV101 cathode is indicated by a green and a brown band.

The BAV102 cathode is indicated by a green and a red band.

The BAV103 cathode is indicated by a green and an orange band.

7Z91084.1

		BAY	<b>/100</b>	BAV101	BAV102	BAV103	
Continuous reverse voltage	$V_{R}$	max.	50	100	150	200	
Repetitive peak reverse voltage	VRRM	max.	60	120	200	250	
Average rectified forward current	IF(AV)	max.			250		
Forward current (d.c.)	1 <sub>F</sub>	max.			250		
Repetitive peak forward current	<sup>I</sup> FRM	max.			625		1
Non-repetitive peak forward current $t < 1 \text{ s}$ ; $T_j = 25  ^{\text{O}}\text{C}$ $t = 1  \mu\text{s}$ ; $T_j = 25  ^{\text{O}}\text{C}$	IFSM IFSM	max. max.			1 5		,
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.		e Januari da	400		1
Storage temperature	T <sub>stg</sub>			-65	to + 175		•
Junction temperature	Tj	max.			175		•
THERMAL RESISTANCE							
From junction to ambient in free air	R <sub>th j-a</sub>	=		O	,375		I
CHARACTERISTICS							
T <sub>i</sub> = 25 <sup>o</sup> C unless otherwise specified							
Forward voltage							
I <sub>F</sub> = 100 mA	٧F	<			1,0		•
I <sub>F</sub> = 200 mA	٧F	<		1	1,25	1	,
Reverse breakdown voltage		BA		BAV101		BAV103	
$I_R = 100 \mu\text{A}$	$V_{(BR)R}$	>	60	120	200	250	١
Reverse current V <sub>R</sub> = V <sub>Rmax</sub>	I <sub>R</sub>	<			100		1
$V_R = V_{Rmax}$ ; $T_i = 150$ °C	I <sub>R</sub>	<			100		
Differential resistance	'H				.00		'
$I_F = 10 \text{ mA}$	<sup>r</sup> diff	typ.			5		5
Diode capacitance	C .	typ.			1,5		i
V <sub>R</sub> = 0; f = 1 MHz	C <sup>d</sup>	<			5,0		1
Reverse recovery time when switched from $I_F = 30$ mA to $I_R = 30$ mA; $R_L = 100 \Omega$ ; measured at							
1 <sub>R</sub> = 3 mA	t <sub>rr</sub>	<			50		

<sup>1)</sup> For sinusoidal operation see Figs 7 to 10. For pulse operation see Figs 3 to 6.
2) At zero life time, measured under pulse conditions to avoid excessive dissipation and voltage limited at 275 V.

## Test circuit and waveforms:

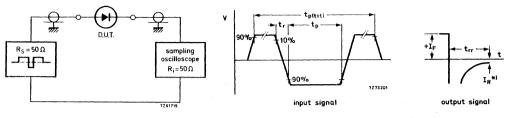


Fig. 2.

\*) I<sub>R</sub> = 3 mA

Input signal:	Total pulse duration	<sup>t</sup> p(tot)	=	2 μs
	Duty factor	δ	=	0,0025
	Rise time of the reverse pulse	tr	=	0,6 ns
	Reverse pulse duration	t <sub>p</sub>	=	100 ns
Oscilloscope:	Rise time	t <sub>r</sub>	=	0,35 ns

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

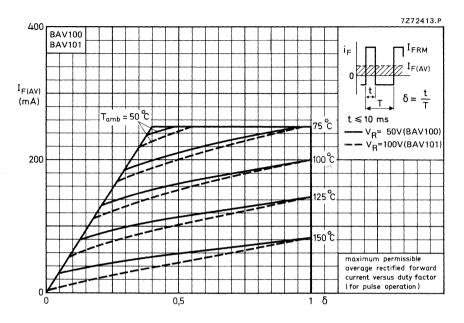


Fig. 3.

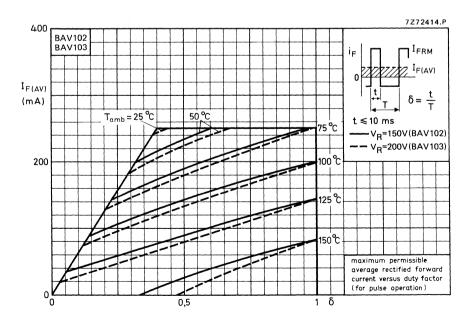


Fig. 4.

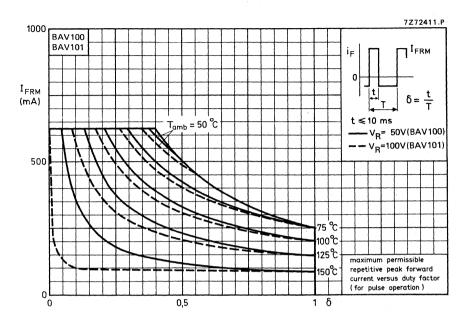


Fig. 5.

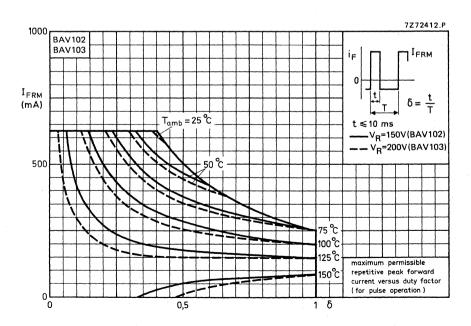


Fig. 6.

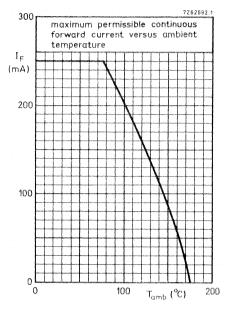


Fig. 7.

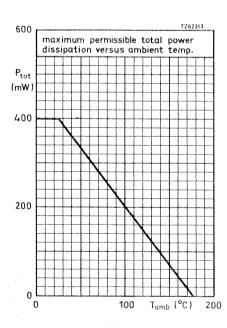


Fig. 9.

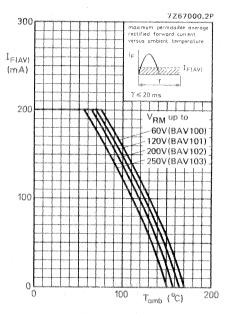


Fig. 8.

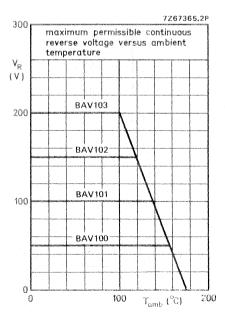


Fig. 10.

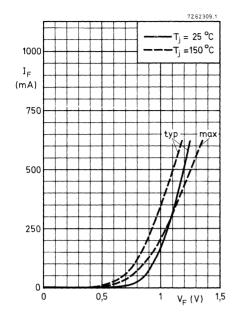


Fig. 11.

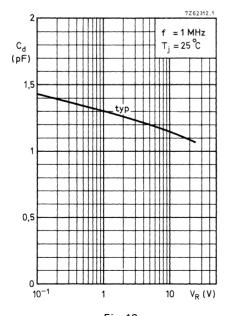


Fig. 13.

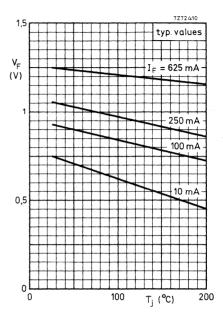


Fig. 12.

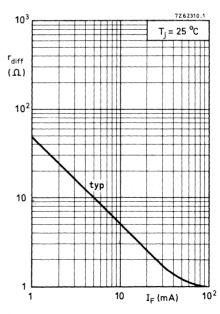


Fig. 14.

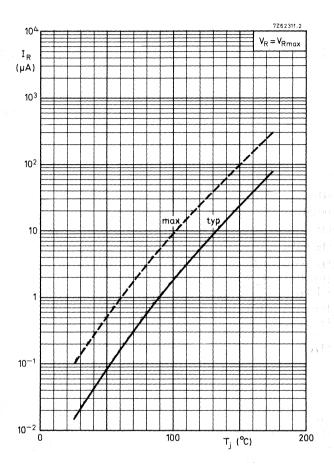


Fig. 15.

## SILICON PLANAR EPITAXIAL HIGH-SPEED DIODES

The BAW56 consists of two diodes in a microminiature plastic envelope. The anodes are commoned and the unit is intended for high-speed switching in thick and thin-film circuits.

## QUICK REFERENCE DATA (per diode)

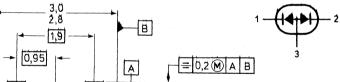
Continuous reverse voltage	$\mathbf{v}_{R}$	max.	70 V
Repetitive peak reverse voltage	VRRM	max.	70 V
Repetitive peak forward current	IFRM	max.	<b>250</b> mA
Junction temperature	† <sub>i</sub>	max.	175 °C
Forward voltage at I <sub>F</sub> = 50 mA	٧ <sub>F</sub>	<	1,0 V
Reverse recovery time when switched from $I_F = 10$ mA to $I_R = 10$ mA; $R_L = 100 \Omega$ ; measured at $I_R = 1$ mA	ter	< 1	6 ns
Recovery charge when switched from $I_F = 10$ mA to $V_R = 5$ V; $R_L = 500$ $\Omega$	$a_{s}$	<	45 pC

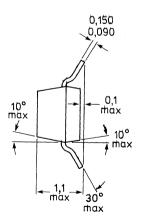
#### **MECHANICAL DATA**

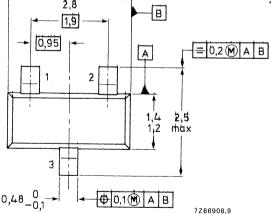
Fig. 1 SOT-23.

Dimensions in mm

Marking code BAW56 = A1







TOP VIEW

See also Soldering recommendations.

RATINGS (per diode)

#### Limiting values in accordance with the Absolute Maximum System (IEC 134) 70 V Continuous reverse voltage ٧ĸ max. 70 V Repetitive peak reverse voltage $V_{RRM}$ max. Average rectified forward current (averaged over any 20 ms period) 250 mA IF(AV) max. Forward current (d.c.) 250 mA 1F max. Repetitive peak forward current 250 mA **IFRM** max. Non-repetitive peak forward current (per crystal) $t = 1 \mu s$ max. 2 A <sup>I</sup>ESM t = 1 ms1 A <sup>I</sup>FSM max. t = 1 s0.5 A <sup>1</sup>FSM max. -65 to + 175 °C Tstg Storage temperature range Junction temperature Τį 175 °C max. THERMAL RESISTANCE\*

# From soldering points to ambient \*\* CHARACTERISTICS (per diode)

From tab to soldering points

T<sub>i</sub> = 25 °C unless otherwise specified

1 mA	IF=	
10 mA	IF=	
50 mA	IF=	
150 m 4	l-=	

Diode capacitance

Forward voltage

From junction to tab

Reverse current	
$V_R = 25 \text{ V}; T_j = 150 ^{\circ}\text{C}$	
V <sub>R</sub> = 70 V	
$V_R = 70 \text{ V}; T_i = 150 ^{\circ}\text{C}$	

$V_R = 0$ ; $t = 1$ MHz	
Forward recovery voltage when switch	ed to
$I_F = 10 \text{ mA}$ ; $t_r = 20 \text{ ns}$	

$v_{F_{A}}$ , $v_{A}$ , $v_{A}$ , $v_{A}$	715 mV
$v_{F}$	855 mV
$V_{F} \sim V_{F} $	<b>1000</b> mV
V <sub>F</sub>	1250 mV
I <sub>R</sub> <	30 μΑ

Rth j-t

Rth t-s

Rth s-a

1<sub>R</sub>

60 K/W

2 x 280 K/W

2 x 90 K/W

2,5 μA

'R		50 μΑ
C <sub>d</sub> ,	o <sup>1</sup> v <sub>o</sub> < − o	2 pF
Vfr	< "	1.75 V

<sup>^</sup> Measured under pulse conditions: pulse time  $t_p \le 0.5$  ms. For sinusoidal operation  $I_{F(AV)} = 150$  mA; averaging time  $t_{(av)} \le 1$  ms.

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

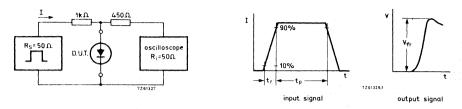


Fig. 2 Test circuit and waveforms; forward recovery voltage.

Input signal: Rise time of the forward pulse  $t_r = 20$  ns

Forward current pulse duration  $t_D$  = 120 ns. Duty factor  $\delta$  = 0,01

Oscilloscope: Rise time  $t_r = 0.35$  ns.

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Reverse recovery time when switched from

$$I_F$$
 = 10 mA to  $I_R$  = 10 mA;  $R_L$  = 100  $\Omega$ ; measured at  $I_R$  = 1 mA

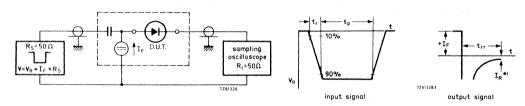


Fig. 3 Test circuit and waveforms; reverse recovery time.

\*) I<sub>B</sub> = 1 mA

45 pC

6 ns

Input signal: Rise time of the reverse pulse  $t_r = 0.6$  ns

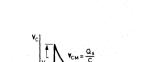
Reverse pulse duration  $t_D = 100$  ns. Duty factor  $\delta = 0.05$ .

Oscilloscope: Rise time  $t_r = 0.35$  ns

Circuit capacitance C ≤ 1 pF (C = oscilloscope input capacitance + parasitic capacitance)

Recovery charge when switched from

$$I_F = 10 \text{ mA to } V_R = 5 \text{ V}; R_L = 500 \Omega$$



output signal

Qç

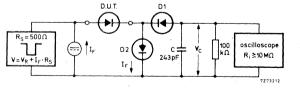


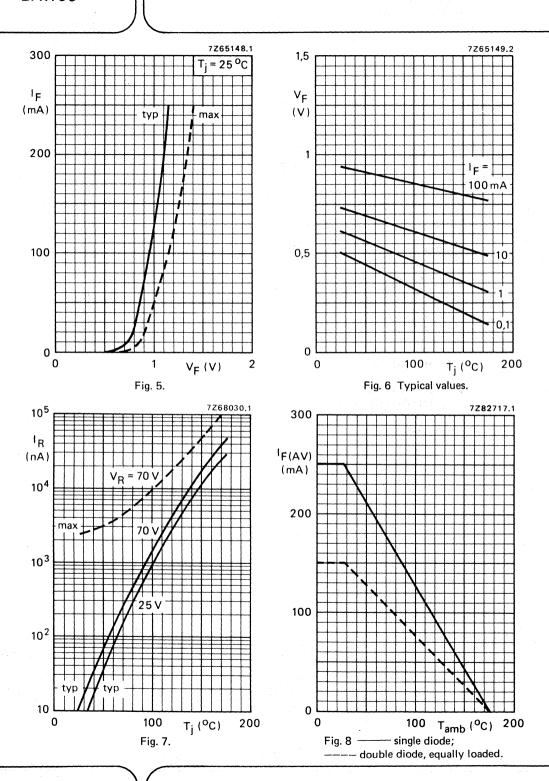
Fig. 4 Test circuit and waveform; recovery charge.

D2 = diode with minority carrier life time at 10 mA:  $\leq$  200 ps. D1 = BAW62.

Input signal: Rise time of the reverse pulse  $t_r = 2$  ns

Reverse pulse duration  $t_p = 400$  ns. Duty factor  $\delta = 0.02$ 

Circuit capacitance C ≤ 7 pF (C = oscilloscope input capacitance + parasitic capacitance).



## **DEVELOPMENT DATA**

This data sheet contains advance information and specifications are subject to change without notice,

## U.H.F. VARIABLE CAPACITANCE DIODE

The BB215 is a silicon variable capacitance diode in a hermetically sealed glass envelope (SOD-80) and intended for application in u.h.f. tuners. The leadless SOD-80 encapsulation is intended for surface mounting.

The diode features a capacitance characteristic with a good linearity.

Diodes are supplied in matched sets and the capacitance difference between any two diodes in one set is less than 3% over the voltage range from 0,5 V to 28 V.

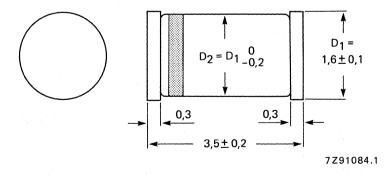
#### QUICK REFERENCE DATA

Continuous reverse voltage	VR	max.	30 V
Reverse current VR = 28 V	I <sub>R</sub>		10 nA
Diode capacitance at $f = 500 \text{ kHz}$ V <sub>R</sub> = 28 V	C <sub>d</sub>	1,8	3 to 2,2 pF
Capacitance ratio at f = 500 kHz	$\frac{C_d(V_R = 1)}{C_d(V_R = 28)}$	<u>V)</u> >	7,6
Series resistance at f = 470 MHz $V_R$ is that value at which $C_d$ = 9 pF	r <sub>s</sub>	typ.	0,63 Ω

#### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOD-80.



The cathode is indicated by a white band on the body and a second green band indicates the BB215 type.

System (IEC 134)		
VR	max.	30 V
1 <sub>F</sub>	max.	20 mA
$T_{stg}$	-55 to	+150 °C
$\mathbf{T}_{j_{i_{1}}}$	max.	100 °C
I <sub>R</sub>		10 nA 200 nA
C <sub>d</sub>	typ.	17 pF 18 pF
C <sub>d</sub>	typ. 1,8 t	11 pF to 2,2 pF
$\frac{C_{d}(V_{R} = 1 V)}{C_{d}(V_{R} = 28 V)}$	> typ.	7,6 8,3
r <sub>s</sub>	typ.	0,63 Ω
	$V_{R}$ $I_{F}$ $T_{stg}$ $T_{j}$ $I_{R}$ $C_{d}$ $C_{d}$ $C_{d}$ $C_{d}$ $C_{d}(V_{R} = 1 V)$ $C_{d}(V_{R} = 28 V)$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

This data sheet contains advance information and specifications are subject to change without notice.

## V.H.F. VARIABLE CAPACITANCE DIODE

The BB219 is a silicon variable capacitance diode in a hermetically sealed glass envelope (SOD-80) and intended for electronic tuning in v.h.f. television tuners for C.A.T.V. applications. The SOD-80 envelope is suitable for surface mounting.

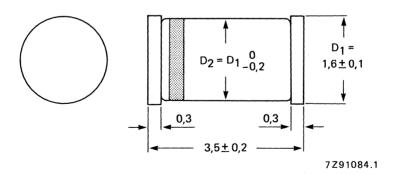
#### QUICK REFERENCE DATA

Reverse voltage, peak value	V <sub>RM</sub>	max. 30 V
Reverse current V <sub>R</sub> = 28 V	,	< 10 nA
Diode capacitance at f = 1 MHz  VR = 1 V  VR = 28 V	C <sub>d</sub>	> 31 pF 2,6 to 3,2 pF
Capacitance ratio at f = 1 MHz	$\frac{C_d(V_R = 1 V)}{C_d(V_R = 28 V)}$	12 to 15
Series resistance at $f = 100 \text{ MHz}$ V <sub>R</sub> is that value at which C <sub>d</sub> = 30 pF	r <sub>s</sub>	typ. 0,7 $\Omega$ < 0,9 $\Omega$

#### **MECHANICAL DATA**

Fig. 1 SOD-80.

Dimensions in mm



Limiting values in accordance with the Absolute Maximum System (IEC 134)				
Reverse voltage, peak value	V <sub>RM</sub>	max. 30 V <b>→</b>		
Forward current (d.c.)	lF	max. 20 mA		
Storage temperature	T <sub>stg</sub>	-55 to +150 °C		
Operating junction temperature	u Tju	max. 100 °C		
THERMAL RESISTANCE				
From junction to ambient in free air	R <sub>th j-a</sub>	= 0,6 K/mW		
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Reverse current V <sub>R</sub> = 28 V V <sub>R</sub> = 28 V; T <sub>amb</sub> = 85 °C	IR	< 10 nA < 200 nA		
Diode capacitance at $f = 0.5$ MHz $V_R = 1$ V $V_R = 3$ V $V_R = 28$ V	C <sub>d</sub> C <sub>d</sub> C <sub>d</sub>	> 31 pF typ. 24 pF 2,6 to 3,2 pF		
Capacitance ratio at f = 1 MHz	$\frac{C_{d}(V_{R} = 1 V)}{C_{d}(V_{R} = 28 V)}$	12 to 15		
Series resistance at $f = 100$ MHz and at that value of $V_R$ at which $C_d = 30  pF$	rs	typ. 0,7 Ω < 0,9 Ω		
Tolerance of capacitance difference between two diodes at V <sub>R</sub> = 1 to 28 V	4 <u>C</u>	< 2,5 %		

## VARIABLE CAPACITANCE DIODE

Silicon planar variable capacitance diode in a microminiature envelope. It is intended for electronic tuning applications in thick and thin-film circuits.

#### QUICK REFERENCE DATA

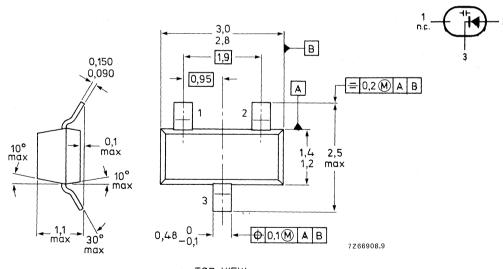
Reverse voltage	v <sub>R</sub>	max.	28 V
Reverse current at $V_R = 28 \text{ V}$	1 <sub>R</sub>	$<$ $^{1}$	50 nA
Diode capacitance at $f = 1 \text{ MHz}$ V <sub>R</sub> = 25 V	C <sub>d</sub>		1,8 to 2,8 pF
Capacitance ratio at f = 1 MHz	$\frac{C_d (V_R = 3 V)}{C_d (V_R = 25 V)}$	typ.	5
Series resistance at $f = 470 \text{ MHz}$ $V_R = \text{that value at which } C_d = 9 \text{ pF}$	r <sub>D</sub>	<	1,2 Ω

## **MECHANICAL DATA**

Dimensions in mm

Marking code BBY31 = S1

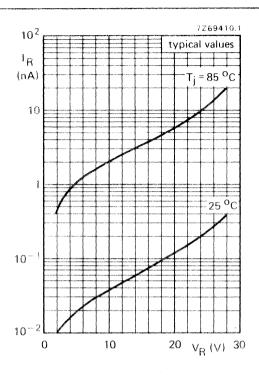
Fig. 1 SOT-23.

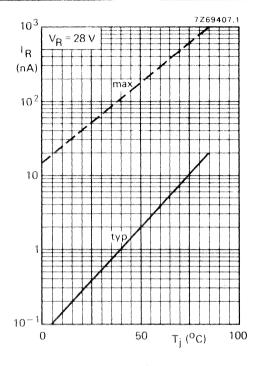


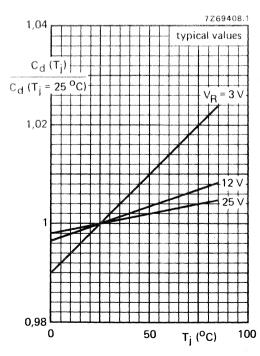
TOP VIEW

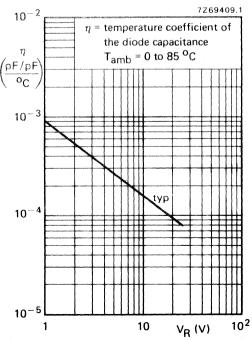
Limiting values in accordance with the Absolute Maximum Syst	tem (IEC 134)			
Continuous reverse voltage	$V_{R}$	max.	28	V
Reverse voltage (peak value)	V <sub>RM</sub>	max.	30	V
Forward current (d.c.) * *	le .	max.	20	mΑ
Storage temperature	T <sub>stg</sub>	-65 to +	100	oC
Operating junction temperature	$T_{j}$	max.	85	οС
THERMAL RESISTANCE				
From junction to ambient*	R <sub>th j-a</sub>		430	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Reverse current				
$V_R = 28 V$	IR	, <	50	nΑ
$V_R = 28 \text{ V}; T_j = 85 ^{\circ}\text{C}$	IR	< 1	000	nΑ
Diode capacitance at f = 1 MHz				_
$V_R = 1 V$	Cd	typ.	17,5	pF
$V_R = 3 V$	Cd	typ.	11,5	pF
$V_R = 25 V$	$c_d$	1,8 to	2,8	pF
Capacitance ratio at f = 1 MHz	$\frac{C_d (V_R = 3 V)}{C_d (V_R = 25 V)}$	typ.	5	
Series resistance at f = 470 MHz				0
and at that value of $V_R$ at which $C_d = 9 pF$	rD	<	1,2	2.4

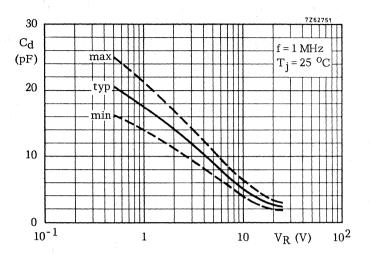
<sup>\*</sup> Mounted on a ceramic substrate of  $7\,\mathrm{mm}\,\mathrm{x}~5\,\mathrm{mm}\,\mathrm{x}~0,5\,\mathrm{mm}.$ 











## SILICON PLANAR VARIABLE CAPACITANCE DIODE

The BBY40 is a variable capacitance diode in a plastic envelope intended for electronic tuning in v.h.f. television tuners with extended band I (FCC and OIRT-norm).

## QUICK REFERENCE DATA

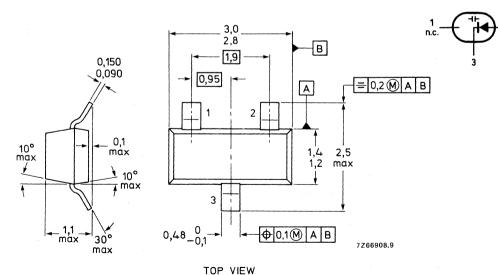
Continuous reverse voltage	V <sub>R</sub>	max.	28 V
Reverse current at V <sub>R</sub> = 28 V	I <sub>R</sub>	<	50 nA
Diode capacitance at f = 1 MHz			
$V_R = 3 V$	$c_d$	26	to 32 pF
V <sub>R</sub> = 25 V	$c_d$	4,	3 to 6 pF
Capacitance ratio at f = 1 MHz	$\frac{C_d (V_R = 3)}{C_d (V_R = 25)}$	_ 5	to 6,5
Series resistance at f = 200 MHz $V_R$ is that value at which $C_d$ = 25 pF	rD	· · · · · · · · · · · · · · · · · · ·	0,6 Ω

## **MECHANICAL DATA**

Dimensions in mm

Marking code BBY40 = S2

Fig. 1 SOT-23.



See also Soldering recommendations.

Limiting values in accordance with the Absolute Maximum Sys	stem (IEC 134)			
Continuous reverse voltage	$v_R$	max.	28	$V_{i}$
Reverse voltage (repetitive peak value)	V <sub>RRM</sub>	max.	30	V
Forward current (d.c.)	l <sub>F</sub>	max.	20	mA
Storage temperature	T <sub>stg</sub>	55 to ∃	100	oC
Operating junction temperature	Tj	max.	85	oC .
THERMAL RESISTANCE				
From junction to ambient*	R <sub>th j-a</sub>	= '	430	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Reverse current		typ.	0,1	nΔ
$V_R = 28 V$	I <sub>R</sub>	τγρ. <		nΑ
$V_R = 28 \text{ V; } T_{amb} = 60 ^{\circ}\text{C}$	IR	<	500	nΑ
Diode capacitance at f = 1 MHz				
$V_R = 3 V$	$c_d$	26	to 32	pΕ
V <sub>R</sub> = 25 V	$c_d$	4,3	8 to 6	pF
Ornesta management of A Malla	$C_d (V_R = 3 V)$			
Capacitance ratio at f = 1 MHz	$\overline{C_d (V_R = 25 V)}$	5 T	o 6,5	
Series resistance at f = 200 MHz		tun	0,4	0
$V_R$ is that value at which $C_d = 25 pF$	rD	typ.	0.6	

<sup>\*</sup> Mounted on a ceramic substrate of 7 mm x 5 mm x 0,5 mm.

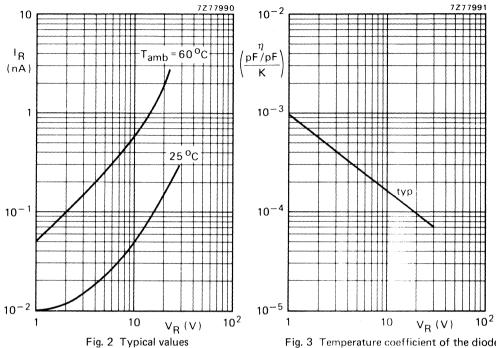


Fig. 3 Temperature coefficient of the diode capacitance; T<sub>amb</sub> = 0 to 85 °C.

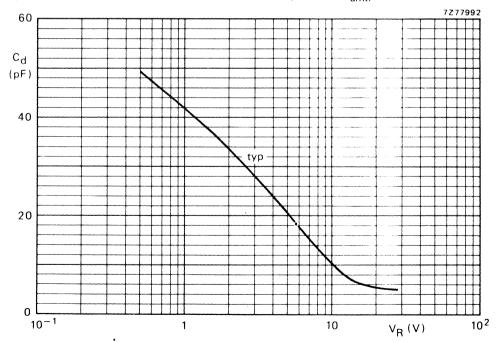


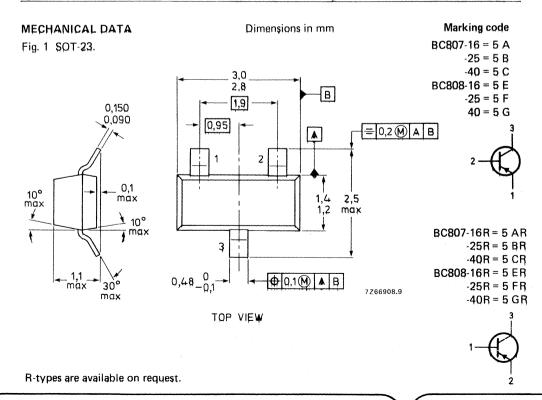
Fig. 4 f = 1 MHz;  $T_{amb} = 25$  °C.

P-N-P transistors, in a SOT-23 plastic envelope for use in driver and output stages of audio amplifiers in thick and thin-film hybrid circuits.

N-P-N complements are BC817; R and BC818; R respectively.

## QUICK REFERENCE DATA

		В	C807	BC80	88
Collector-emitter voltage (V <sub>BE</sub> = 0) Collector-emitter voltage (open base)	−V <sub>CES</sub> −V <sub>CEO</sub>	max.	50 45		0 V 5 V
Collector current (peak value)	-ICM	max.	10	00	mA
Total power dissipation up to Tamb = 35 °C	$P_{tot}$	max.	3	10	mW
Junction temperature	$T_{j}$	max.	1	50	oC
Transition frequency at $f = 35 \text{ MHz}$ -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 5 V	f <sub>T</sub>	typ.	. 1	00	MHz



Limiting values in accordance with the Absolute Maximum System (IEC 134)

		В	C807	BC808	
Collector-emitter voltage (V <sub>BE</sub> = 0)	-V <sub>CES</sub>	max.	50	30	V
Collector-emitter voltage (open base)					
$-I_C = 10 \text{ mA}$	$-\Lambda$ CEO	max.	45	25	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	V
Collector current (d.c.)	$-I_{\mathbf{C}}$	max.	5	00	mΑ
Collector current (peak value)	-ICM	max.	10	00	mΑ
Emitter current (peak value)	IEM	max.	10	00	mΑ
Base current (d.c.)	$-I_B$	max.	11	00	mA
Base current (peak value)	-IBM	max.	2	00	mΑ
Total power dissipation at T <sub>amb</sub> = 35 °C *	P <sub>tot</sub>	max.	3	10	mW
Storage temperature	T <sub>stg</sub>	-	-65 to + 1	50	оС
Junction temperature	$T_{j}$	max.	1	50	oC
THERMAL CHARACTERISTICS **					
$T_j = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab	R <sub>th j-t</sub>	= "."		50	K/W
From tab to soldering points	R <sub>th t-s</sub>	. ≝	2	60	K/W
From soldering points to ambient *	R <sub>th s-a</sub>	- 1		60	K/W
i rom soldering points to unblent	tu s-a			~~	,

<sup>\*</sup> Mounted on a ceramic substrate of 15 mm  $\times$  15 mm  $\times$  0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

## **CHARACTERISTICS**

	,	100
-ICBO	<	100 nA
-ICBO	<	5 μΑ
-lEBO	<'	10 μΑ
$-V_{BE}$	<	1,2 V
$-V_{CEsat}$	<	700 mV
hFE	>	40
hFE	100 to	o 600
hee	100 to	o 250
- L		
hFE	160 to	o 400
hFF	250 to	o 600
fT	typ.	100 MHz
$C_{\mathbf{c}}$	typ.	8 pF
	-IEBO -VBE -VCEsat hFE hFE hFE hFE	-ICBO < -IEBO < -VBE < -VCEsat < hFE

 $<sup>^{\</sup>ast}$   $-V_{BE}$  decreases by about 2 mV/K with increasing temperature.

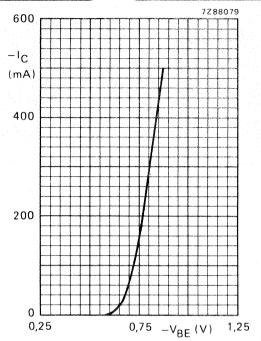


Fig. 2  $-V_{CE} = 1 \text{ V; T}_{j} = 25 \text{ °C.}$ Typical values.

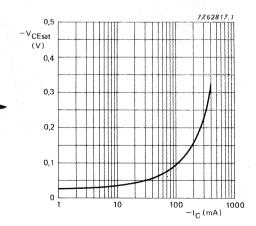


Fig. 4 typical values.

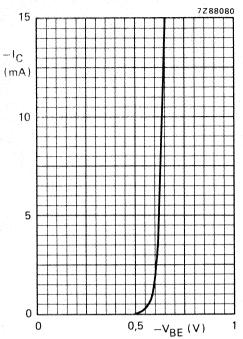
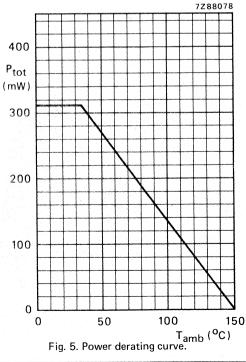


Fig. 3  $-V_{CE} = 5 \text{ V; T}_{j} = 25 \text{ °C.}$ Typical values.



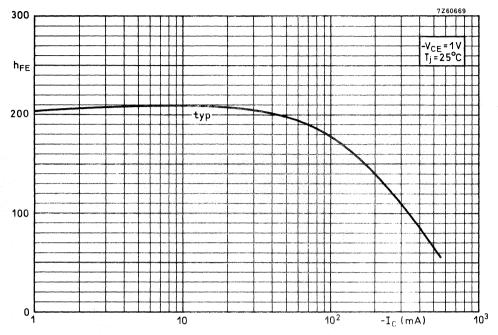


Fig. 6 D.C. current gain.

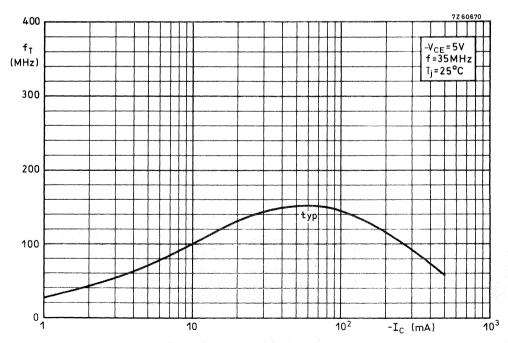


Fig. 7 Typical values transition frequency.

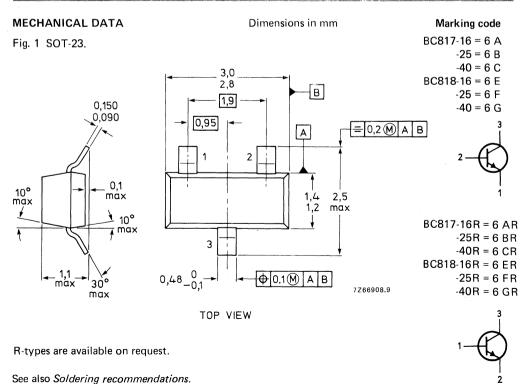


N-P-N transistors, in a SOT-23 plastic envelope for use in driver and output stages of audio amplifiers in thick and thin-film hybrid circuits.

P-N-P complements are BC807; R and BC808; R respectively.

## QUICK REFERENCE DATA

		ВС	C817	ВС	818
Collector-emitter voltage (V <sub>BE</sub> = 0)	$V_{CES}$	max.	50		30 V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	45		25 V
Collector current (peak value)	I <sub>CM</sub>	max.		1000	mA
Total power dissipation up to $T_{amb} = 35$ °C	$P_{tot}$	max.		310	mW
Junction temperature	$T_{j}$	max.		150	oC
Transition frequency at f = $35 \text{ MHz}$ I <sub>C</sub> = $10 \text{ mA}$ ; V <sub>CE</sub> = $5 \text{ V}$	f <sub>T</sub>	typ.		200	MHz



Limiting values in accordance with the Absolute Maximum System (IEC 134)

		BC817	BC818	3
Collector-emitter voltage (V <sub>BE</sub> = 0)	V <sub>CES</sub>	max. 50	30	) V
Collector-emitter voltage (open base)				
$I_C = 10 \text{ mA}$	VCEO	max. 45	2	5 V
Emitter-base voltage (open collector)	VEBO	max. 5		5 V
Collector current (d.c.)	IC	max.	500	mΑ
Collector current (peak value)	<sup>I</sup> CM	max.	1000	mΑ
Emitter current (peak value)	-IEM	max.	1000	mΑ
Base current (d.c.)	IB	max.	100	mΑ
Base current (peak value)	Iвм	max.	200	mΑ
Total power dissipation up to $T_{amb} = 35$ °C	P <sub>tot</sub>	max.	310	mW
Storage temperature	$T_{stg}$		-65 to +150	οС
Junction temperature	T <sub>j</sub>	max.	150	οС
THERMAL CHARACTERISTICS **				
$T_j = P(R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	Ħ <sub>th j-t</sub>	=	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	* <del>=</del> ***	260	K/W
From soldering points to ambient *	R <sub>th s-a</sub>	= 	60	K/W

<sup>\*</sup> Mounted on a ceramic substrate of 15 mm  $\times$  15 mm  $\times$  0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

T: = 25 °C unless otherwise specified

CHARACTERISTICS

The Common Commo			
Collector cut-off current $I_E = 0$ ; $V_{CB} = 20 \text{ V}$ ; $T_j = 25 ^{\circ}\text{C}$	СВО	<	100 nA
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$ ; $T_j = 150 ^{\circ}\text{C}$	Ісво	<	5 μΑ
Emitter cut-off current $I_C = 0$ ; $V_{EB} = 5 \text{ V}$	I <sub>EBO</sub>	<	10 μΑ
Base emitter voltage * $I_C = 500 \text{ mA; } V_{CE} = 1 \text{ V}$	$V_{BE}$	<	1,2 V
Saturation voltage $I_C = 500 \text{ mA}$ ; $I_B = 50 \text{ mA}$	V <sub>CEsat</sub>	<	700 mV
D.C. current gain $I_C = 500 \text{ mA; } V_{CE} = 1 \text{ V}$	hFE	>	40

 $I_C = 500 \text{ mA}; V_{CE} = 1 \text{ V}$  $I_C = 100 \text{ mA}$ ;  $V_{CE} = 1 \text{ V}$ ; BC817; BC818 BC817-16 BC818-16 BC817-25 BC818-25 BC817-40 BC818-40

160 to 400 hFE 250 to 600 hFF

hFE

hFE

fΤ

Transition frequency at f = 35 MHz  $I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$ Collector capacitance at f = 1 MHz  $I_E = I_e = 0$ ;  $V_{CB} = 10 \text{ V}$ 

typ.  $C_{c}$ 5 pF typ.

100 to 600

100 to 250

200 MHz

\* VBE decreases by about 2 mV/K with increasing temperature.

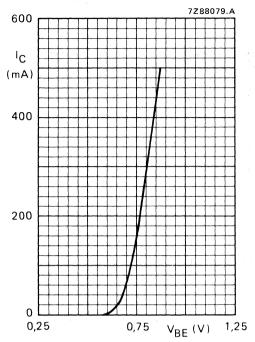


Fig. 2  $V_{CE}$  = 1 V;  $T_j$  = 25 °C. Typical values.

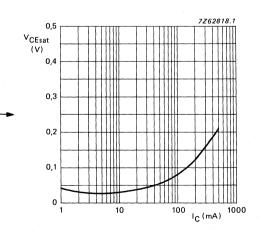


Fig. 4  $I_C/I_B = 10$ ;  $T_j = 25 \, {}^{\circ}C$ .

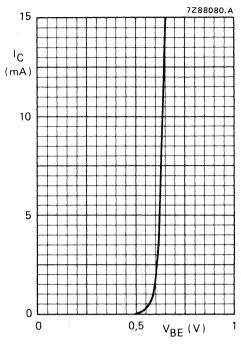


Fig. 3  $V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \text{ °C}$ . Typical values.

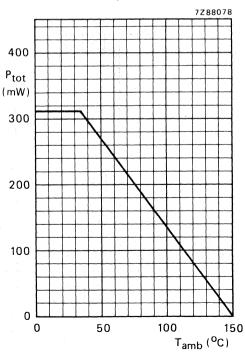


Fig. 5 Power derating curve.

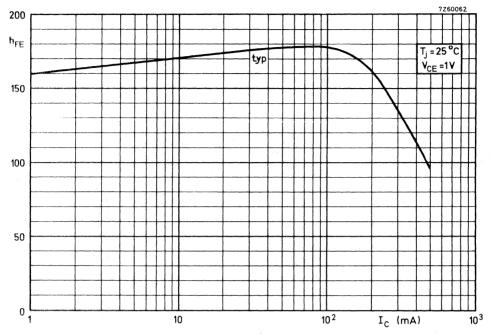


Fig. 6 D.C. current gain.

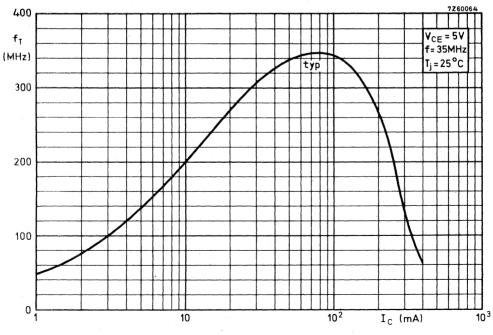
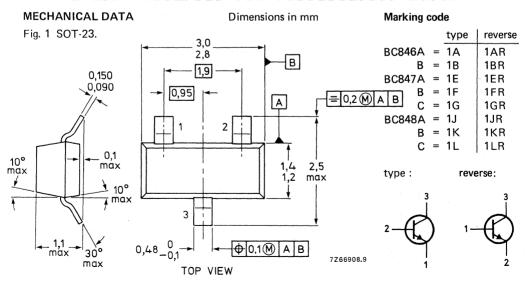


Fig. 7 Typical values transition frequency.

General purpose n-p-n transistors in a plastic SOT-23 variant, especially suitable for use in driver stages of audio amplifiers in thick and thin-film hybrid circuits.

#### QUICK REFERENCE DATA

			BC846	BC847	BC848	
Collector-emitter voltage ( $V_{BE} = 0$ )	$v_{CES}$	max.	80	50	30	٧
Collector-emitter voltage (open base)	$v_{CEO}$	max.	65	45	30	V
Collector current (peak value)	ICM	max.	200	200	200	mA
Total power dissipation up to T <sub>amb</sub> = 60 °C Junction temperature	P <sub>tot</sub>	max. max.	200 150	200 150	200 150	mW °C
Small-signal current gain IC = 2 mA; VCE = 5 V; f = 1 kHz	T <sub>j</sub> h <sub>fe</sub>	> <	125 500	125 900	125 900	-0
Transition frequency I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 5 V	fT	typ.	300	300	300	MHz
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CE</sub> = 5 V f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	dB



R-types are available on request See also *Soldering recommendations*.

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BC846	BC847	BC848	
Collector-base voltage (open emitter)	$v_{CBO}$	max.	80	50	30	V
Collector-emitter voltage (V <sub>BE</sub> = 0)	V <sub>CES</sub>	max.	80	50	30	V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	65	45	30	V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	6	6	5	V
Collector current (d.c.)	Ic	max.		100		mA
Collector current (peak value)	I <sub>CM</sub>	max.		200		mΑ
Emitter current (peak value)	-IEM	max.		200		mΑ
Base current (peak value)	I <sub>BM</sub>	max.		200		mΑ
Total power dissipation*						
up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.		200		mW
Storage temperature	T <sub>stg</sub>		-65 t	o + 150		oC
Junction temperature	Τj	max.		150		oC
THERMAL CHARACTERISTICS**						

#### THERMAL CHARACTERISTICS\*\*

$$T_j = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$

## Thermal resistance

From junction to tab	R <sub>th j-t</sub>	=	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient*	R <sub>th s-a</sub>	=	90	K/W

<sup>\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

BC846 BC847 BC848

#### CHARACTERISTICS

T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified			
Collector cut-off current $I_E = 0$ ; $V_{CB} = 30 \text{ V}$ $I_E = 0$ ; $V_{CB} = 30 \text{ V}$ ; $T_j = 150 ^{\circ}\text{C}$	ICBO ICBO	< < <sup>2</sup> 1	15 nA 5 μA
Base-emitter voltage* I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V	V <sub>BE</sub>	typ. 580 to	660 mV 700 mV
$I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	$v_BE$	<	770 mV
Saturation voltage** $I_C = 10 \text{ mA}; I_B = 0.5 \text{ mA}$	V <sub>CEsat</sub>	typ.	90 mV 250 mV
	$V_{BEsat}$	typ.	700 mV
$I_C = 100 \text{ mA}; I_B = 5 \text{ mA}$	V <sub>CEsat</sub>	typ.	200 mV 600 mV
	$V_{BEsat}$	typ.	900 mV
Collector capacitance at f = 1 MHz $I_E = I_e = 0$ ; $V_{CB} = 10 V$	C <sub>c</sub>	typ.	2,5 pF
Transition frequency at f = 35 MHz $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	300 MHz

 $<sup>^{*}</sup>$   $\,$  VBE decreases by about 2 mV/K with increasing temperature.  $^{**}$  VBEsat decreases by about 1,7 mV/K with increasing temperature.

Constitutional account with the first first			BC846	BC847	BC848	
Small signal current gain at $f = 1 \text{ kHz}$ $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	h <sub>fe</sub>	> <	125 500	125 900	125 900	
Noise figure at R <sub>S</sub> = 2 k $\Omega$						
$I_C = 200 \mu A; V_{CE} = 5 V;$ f = 1 kHz; B = 200 Hz	F	typ.	2 10	2 10	2 10	dB dB
			BC846A BC847A BC848A	BC846B BC847B BC848B	BC847C BC848C	
D.C. current gain					500.00	
$I_C = 10 \mu\text{A};  V_{CE} = 5 \text{V}$	hFE	typ.	90	150	270	
I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V	hFE	> typ.	110 180	200 290	420 520	
		< '	220	450	800	

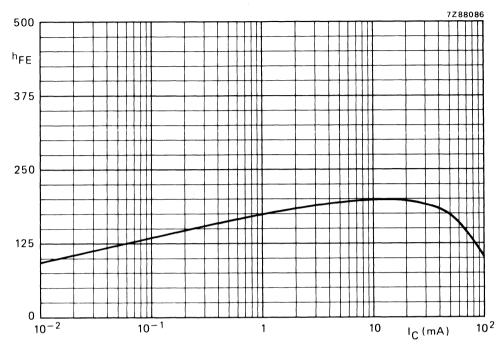


Fig. 3 Typical D.C. current gain for A-selections.  $V_{CE}$  = 5 V;  $T_j$  = 25 °C.

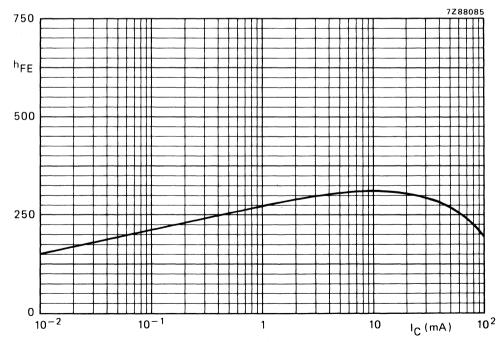


Fig. 4 Typical D.C. current gain for B-selections.  $V_{CE}$  = 5 V;  $T_j$  = 25 °C.

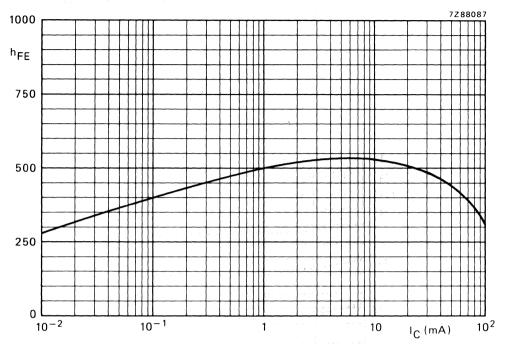


Fig. 5 Typical D.C. current gain for C-selections.  $V_{CE}$  = 5 V;  $T_j$  = 25 °C.

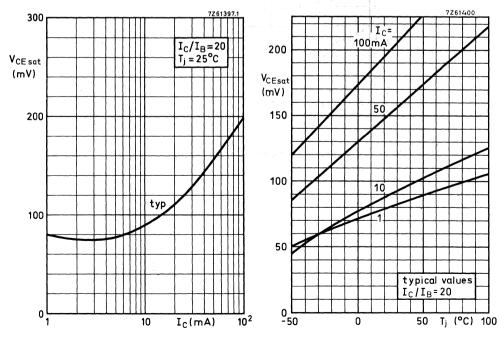


Fig. 6 Typical values.

Fig. 7 Typical values.

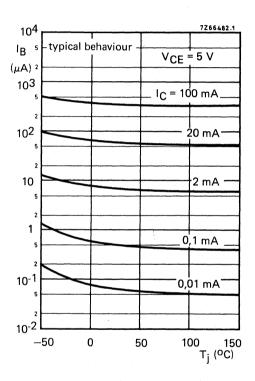


Fig. 8 Typical behaviour of base current versus junction temperature.

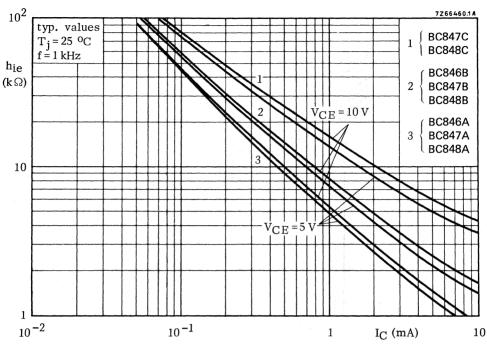


Fig. 9 Input impedance. 1 = C selections; 2 = B selections; 3 = A selections.

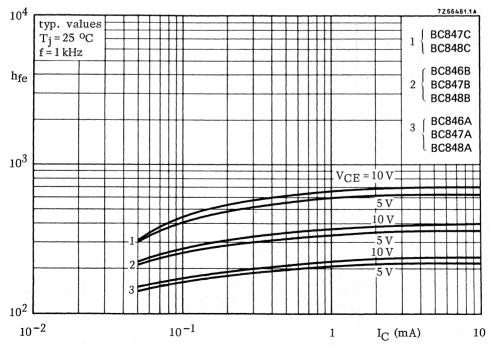


Fig. 10 Small signal current gain. 1 = C-; 2 = B- and 3 = A-selections.

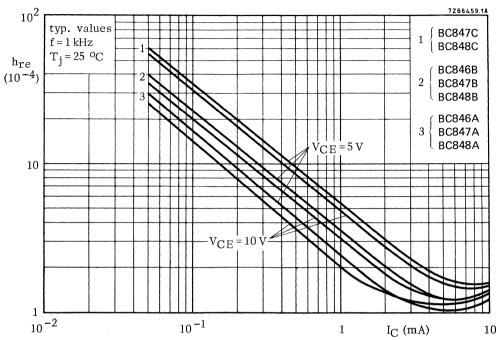


Fig. 11 Reverse voltage transfer ratio. 1 = C-; 2 = B- and 3 = A-selections.

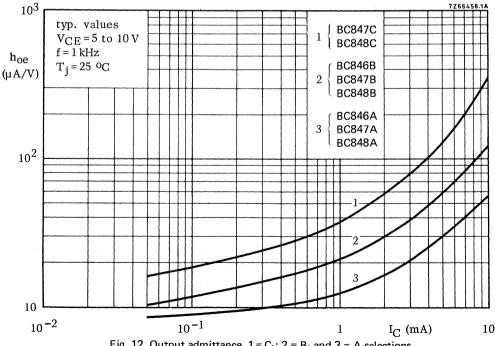
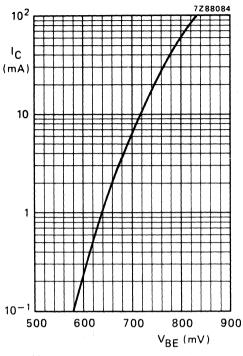


Fig. 12 Output admittance. 1 = C-; 2 = B- and 3 = A-selections.



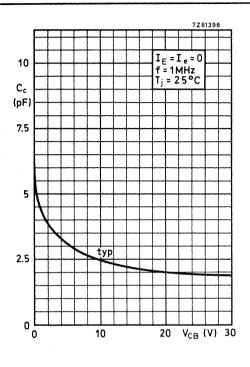


Fig. 13 Typical values at  $V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \text{ }^{\circ}\text{C}$ .



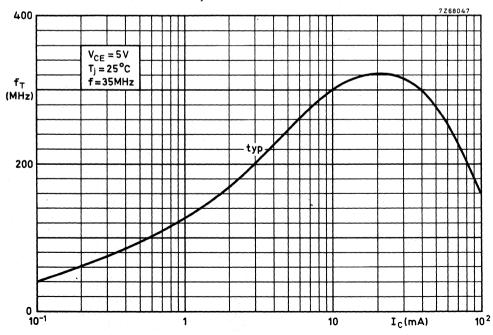
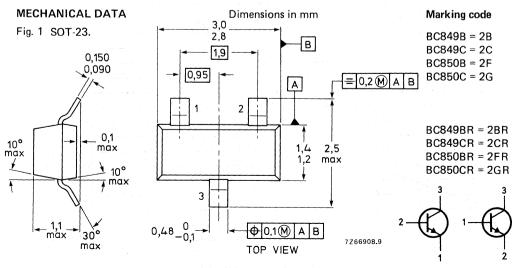


Fig. 15 Typical values transition frequency.

N-P-N transistors in a plastic SOT-23 envelope, primarily intended for low-noise input stages in tape recorders, hi-fi amplifiers and other audio-frequency equipment in thick and thin-film hybrid circuits.

## QUICK REFERENCE DATA

			BC849	BC850	
Collector-emitter voltage (V <sub>BE</sub> = 0)	$v_{CES}$	max.	30	50	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	30	45	V
Collector current (peak value)	<sup>1</sup> CM	max.	200	200	mA
Total power dissipation up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.	200	200	mW
Junction temperature	Ti	max.	150	150	oC
Small-signal current gain $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 1 \text{ kHz}$	h <sub>fe</sub>	> <	240 900	240 900	
Transition frequency IC = 10 mA; VCE = 5 V	f <sub>T</sub>	typ.	300	300	MHz
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CF</sub> = 5 V					
f = 30 Hz to 15 kHz	F	typ.	1,4 4	1,4	dB dB
f = 1 kHz; B = 200 Hz	F.	typ.	1,2	1	dB
f = 10 Hz to 50 Hz (equivalent noise voltage)	$V_n$	<	<del>-</del> ;	0,135	μV



R-types are available on request

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BC849	BC850	
Collector-base voltage (open emitter)	$v_{CBO}$	max.	30	50	V
Collector-emitter voltage (V <sub>BE</sub> = 0)	VCES	max.	30	50	V
Collector-emitter voltage (open base)	VCEO	max.	30	45	V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	5	5	V
Collector current (d.c.)	IC	max.	1	00	mA
Collector current (peak value)	ICM	max.	2	00	mA
Emitter current (peak value)	-IEM	max.	2	00	mA
Base current (peak value)	IBM	max.	2	00	mA
Total power dissipation up to T <sub>amb</sub> = 60 °C**	$P_{tot}$	max.	200		mW
Storage temperature	T <sub>stg</sub>		-65  to + 150		
Junction temperature	$\tau_j$	max.	1	50	oC
THERMAL CHARACTERISTICS*					
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab	R <sub>th j-t</sub>	=		60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	2	80	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=		90	K/W

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.

## **CHARACTERISTICS**

T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified			
Collector cut-off current I <sub>E</sub> = 0; V <sub>CB</sub> = 30 V	ІСВО	<	15 nA
$I_E = 0$ ; $V_{CB} = 30 \text{ V}$ ; $T_j = 150 ^{\circ}\text{C}$	Ісво	<	5 μΑ
Base emitter voltage* $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	V <sub>BE</sub>	typ. 580 to	660 mV 5 700 mV
$I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	$V_{BE}$	<	770 mV
Saturation voltages** $I_C = 10 \text{ mA}; I_B = 0.5 \text{ mA}$	V <sub>CEsat</sub>	typ.	90 mV 250 mV
	$V_{BEsat}$	typ.	700 mV
$I_C = 100 \text{ mA}; I_B = 5 \text{ mA}$	$v_{CEsat}$	typ.	200 mV 600 mV
	$V_{BEsat}$	typ.	900 mV
Collector capacitance at $f = 1$ MHz $I_E = I_e = 0$ ; $V_{CB} = 10$ V	C <sub>c</sub>	typ.	2,5 pF
Transition frequency at $f = 35 \text{ MHz}$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	fT	typ.	300 MHz

 $<sup>^{\</sup>ast}$   $\,$  VBE decreases by about 2 mV/K with increasing temperature.  $^{\ast\ast}$   $\,$  VBEsat decreases by about 1,7 mV/K with increasing temperature.

# BC849 BC850

			BC849	BC850	
Small signal current gain at $f = 1 \text{ kHz}$ $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	h <sub>fe</sub>	> <	240 900	240 900	
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CF</sub> = 5 V					
f = 30 Hz to 15 kHz	F	typ.	1,4 4	1,4 3	dB dB
f = 1 kHz; B = 200 Hz	F	typ.	1,2 4	1. 4	dB dB
Equivalent noise voltage at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CE</sub> = 5 V				4 Sec. 1	
f = 10 Hz to 50 Hz; T <sub>amb</sub> = 25 °C	$\mathbf{v}_{n}$	max.		0,135	μV
D.C. current gain $I_C = 10 \mu A; V_{CF} = 5 V$	<b>.</b>		B-selections 150	C-selection	ns
1C = 10 μA, VCE = 5 V	hFE	typ.	200	420	
$I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	h <sub>FE</sub>	typ.	290 450	520 800	

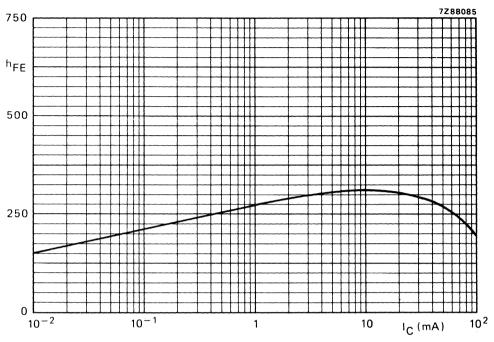


Fig. 3 Typical D.C. current gain B selections.  $V_{CE}$  = 5 V;  $T_j$  = 25 °C.

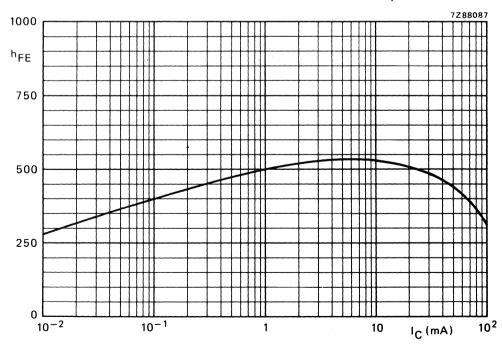
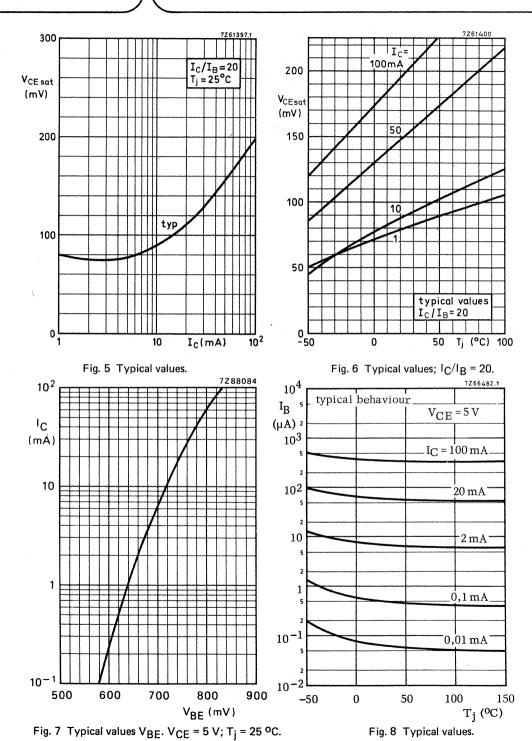


Fig. 4 Typical D.C. current gain C selections.  $V_{CE}$  = 5 V;  $T_j$  = 25 °C.



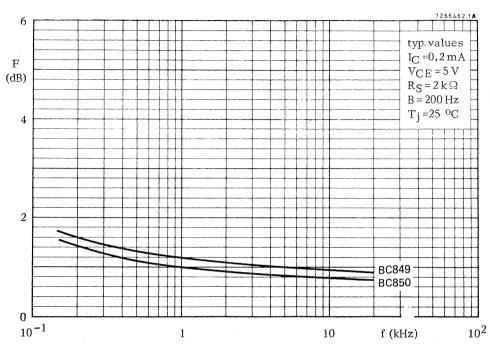


Fig. 9.

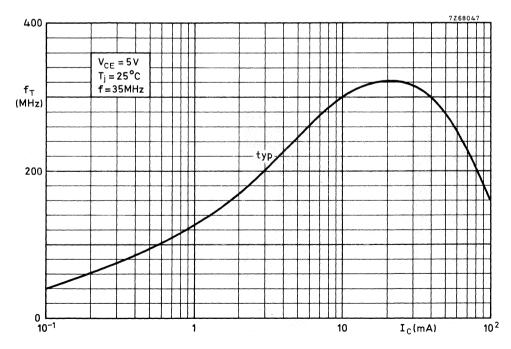


Fig. 10.

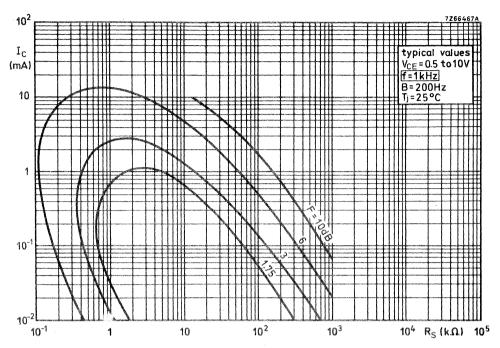


Fig. 11 Curves of constant noise figure for BC849.

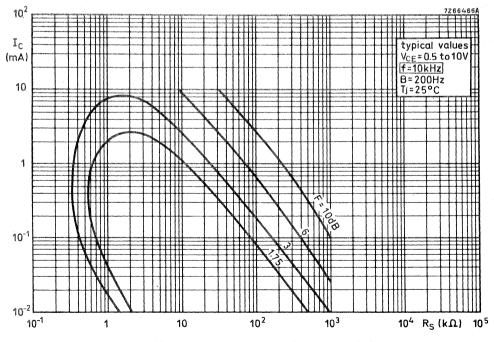
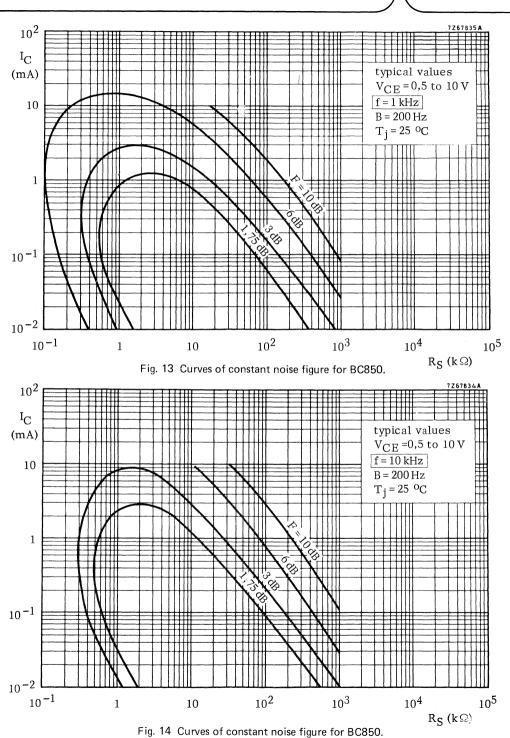


Fig. 12 Curves of constant noise figure for BC849.



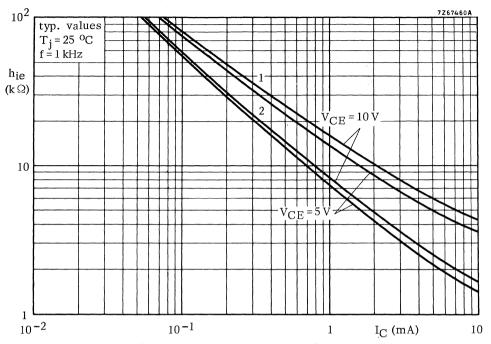


Fig. 15 Typical values. 1 = C selections; 2 = B selections.

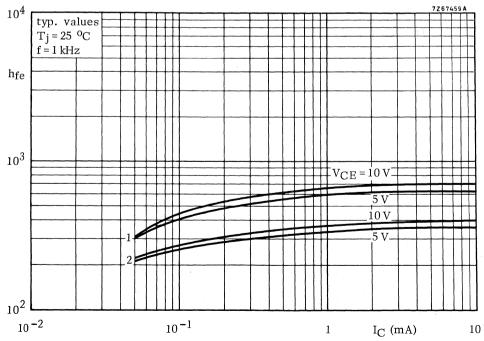


Fig. 16 Typical values. 1 = C selections; 2 = B selections.

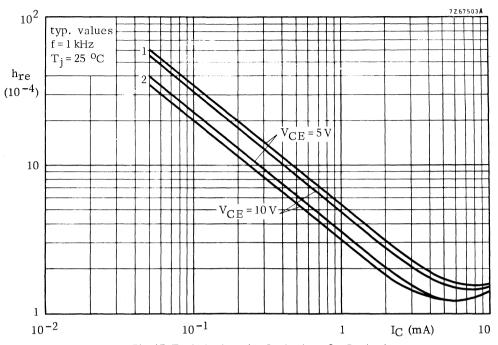


Fig. 17 Typical values. 1 = C selections; 2 = B selections.

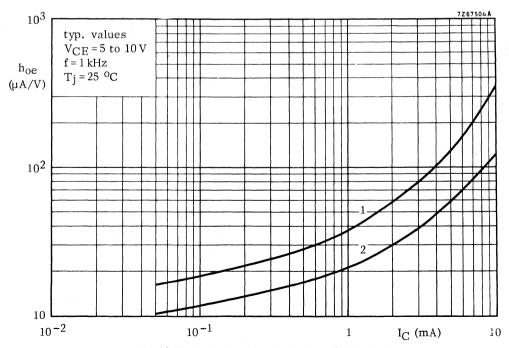


Fig. 18 Typical values. 1 = C selections; 2 = B selections.

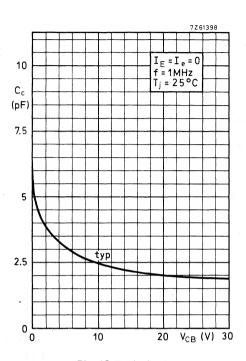


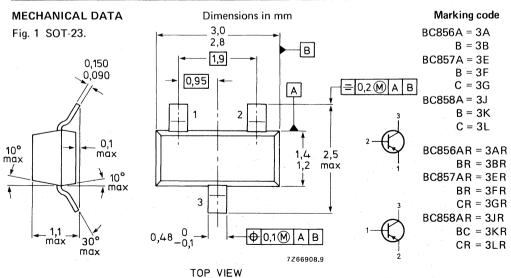
Fig. 19 Typical values.

## SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a SOT-23 plastic envelope for use in driver and output stages of audio amplifiers in thick and thin-film circuits.

#### QUICK REFERENCE DATA

		BC856	BC857	BC858
Collector-emitter voltage (+ V <sub>BE</sub> = 1 V)	-V <sub>CEX</sub>	max. 80	50	30 V
Collector-emitter voltage (open base)	$-v_{CEO}$	max. 65	45	30 V
Collector current (peak value)	-1 <sub>СМ</sub>	max.	200	mA
Total power dissipation up to $T_{amb} = 60  {}^{\circ}\text{C}$	P <sub>tot</sub>	max.	200	mW
Junction temperature	Ti	max.	150	оС
Small-signal current gain $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; f = 1 \text{ kHz}$	h <sub>fe</sub>	7	'5 to 900	
Transition frequency at $f = 35 \text{ MHz}$ $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	150	MHz
Noise figure at R <sub>S</sub> = $2 \text{ k}\Omega$ $-\text{I}_{\text{C}}$ = $200 \mu\text{A}$ ; $-\text{V}_{\text{CE}}$ = $5 \text{ V}$ f = $1 \text{ kHz}$ ; B = $200 \text{ Hz}$	F	<	10	dB



R-types are available on request

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance with the Absor	iato maximi		BC856	BC857	BC85	3
Collector-base voltage (open emitter)	-Усво	max.	80	50	30	V
Collector-emitter voltage (+ V <sub>BE</sub> = 1 V)	-V <sub>CEX</sub>	max.	80	50	30	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	65	45	30	V
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	5	5	5	٧
Collector current (d.c.)	-Ic	max.		100		mA
Collector current (peak value)	-I <sub>CM</sub>	max.		200		mΑ
Emitter current (peak value)	I <sub>EM</sub>	max.		200		mΑ
Base current (peak value)	-I <sub>BM</sub>	max.		200		mΑ
Total power dissipation ** up to T <sub>amb</sub> = 60 °C	P <sub>tot</sub>	max.		200		mW
Storage temperature	T <sub>stg</sub>			-65 to +150		oC
Junction temperature	Tj	max.		150		oC
THERMAL CHARACTERISTICS*						
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$						
Thermal resistance						
From junction to tab	R <sub>th j-t</sub>	=		60		K/W
From tab to soldering points	R <sub>th t-s</sub>	_ =		280		K/W
From soldering points to ambient **	R <sub>th s-a</sub>	_	- 14 (1) - 14 (1)	90		K/W
CHARACTERISTICS						
T <sub>i</sub> = 25 °C unless otherwise specified						
Collector cut-off current		tvo		1		nΑ
$I_E = 0$ ; $-V_{CB} = 30 \text{ V}$ ; $T_j = 25  {}^{\circ}\text{C}$	-Ісво	typ.		15		nΑ
T <sub>j</sub> = 150 °C	-Ісво	<		4		μΑ
Base-emitter voltage ▲						
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	-V <sub>BE</sub>	typ.		650 600 to 750		mV mV
$-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	-V <sub>BE</sub>	<		820		mV

 $<sup>^{</sup>lack}$  -V<sub>BE</sub> decreases by about 2 mV/K with increasing temperature.

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Saturation voltages *					
$-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ m}$	Α	V <sub>CEsat</sub>	typ.	75 r 300 r	
		$-V_{BEsat}$	typ.	700 r	nV .
$-I_C = 100 \text{ mA}; -I_B = 5 \text{ m/s}$	4	-V <sub>CEsat</sub>	typ.	250 r 650 r	
		-V <sub>BEsat</sub>	typ.	850 1	ηV
Knee voltage					
$-I_C = 10 \text{ mA}; -I_B = \text{value}$ $-I_C = 11 \text{ mA at } -V_{CE} = 1$		-V <sub>CEK</sub>	typ.	250 i	
Collector capacitance at $f = 1$ $I_E = I_e = 0$ ; $-V_{CB} = 10 \text{ V}$	MHz	$C_c$	typ.	4,5	ρF
Transition frequency at $f = 35$ $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$		fΤ	typ.	150	MHz
Small-signal current gain at f = $-I_C = 2 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	= 1 kHz	h <sub>fe</sub>	75 to	o <b>900</b>	
Noise figure at R <sub>S</sub> = $2 \text{ k}\Omega$ $-\text{I}_{\text{C}}$ = $200 \mu\text{A}$ ; $-\text{V}_{\text{CE}}$ = $5 ^{\circ}$ f = $1 \text{kHz}$ ; B = $200 \text{Hz}$	V	F	typ.	2 ( 10 (	
D.C. current gain -IC = 2 mA; -VCE = 5 V	BC856/857 BC858	hFE hFE	75 to	o 475 o 800	
	BC856A/857A/858A	hFE	125 t	o 250	
	BC856B/857B/858B	hFE	220 t	o 475	
	BC857C/858C	hFE	420 t	o 800	

 $<sup>^*</sup>$  -V<sub>BEsat</sub> decreases by about 1,7 mV/K with increasing temperature.

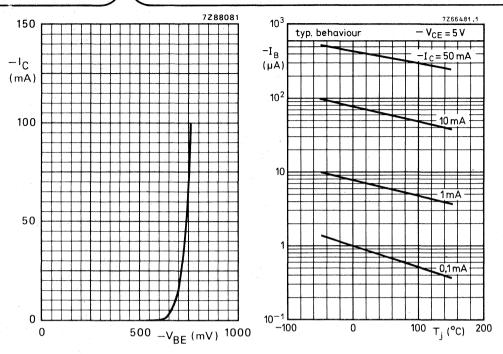
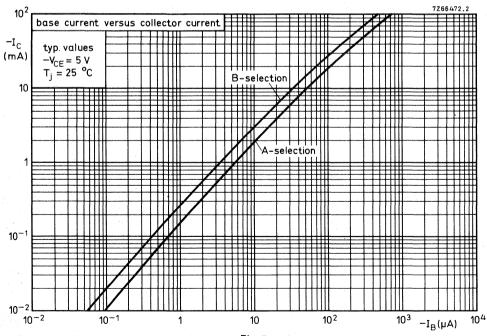


Fig. 3 Typical values.  $-V_{CE} = 5 \text{ V}$ ;  $T_i = 25 ^{\circ}\text{C}$ .

Fig. 4 Typical values.



BC856 BC857 BC858

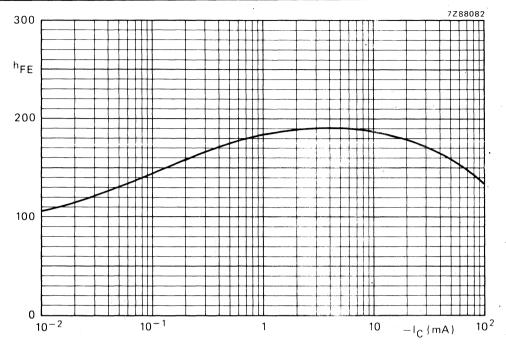
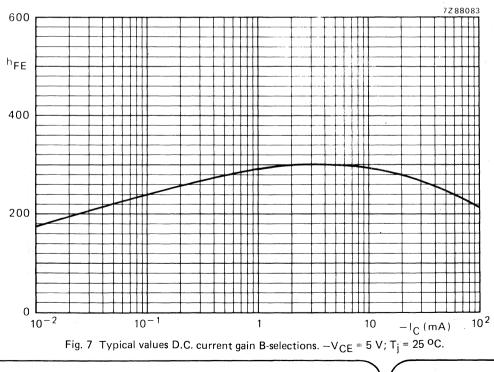


Fig. 6 Typical values D.C. current gain A-selections.  $-V_{CE}$  = 5 V;  $T_j$  = 25 °C.



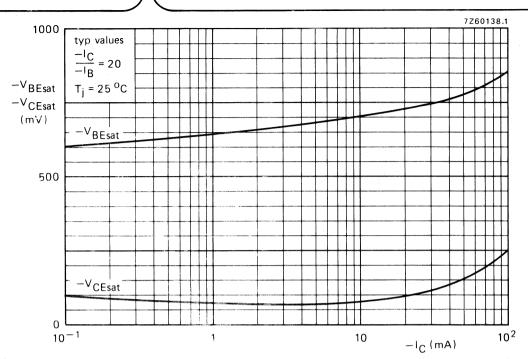


Fig. 8 Typical values base-emitter and collector-emitter saturation voltage.

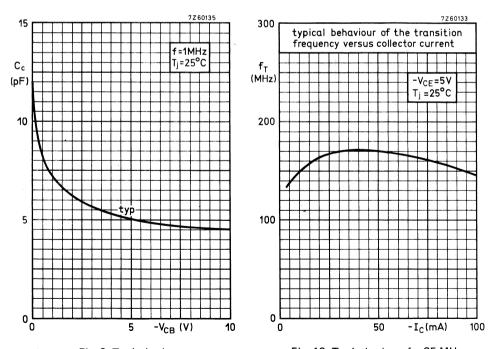
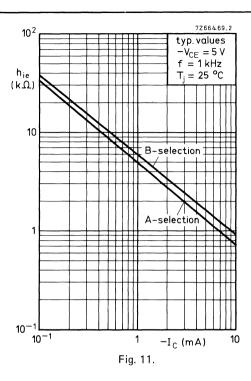
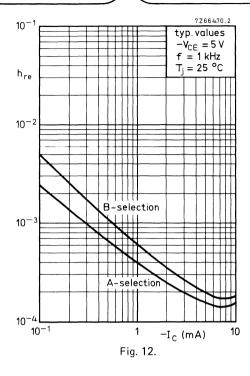


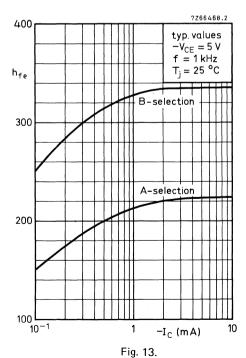
Fig. 9 Typical values.

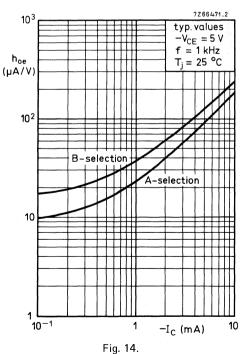
Fig. 10 Typical values. f = 35 MHz.

BC856 BC857 BC858









## SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in a plastic SOT-23 envelope, primarily intended for low-noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment in thick and thin-film hybrid circuits.

#### QUICK REFERENCE DATA

			BC859	BC860	
Collector-emitter voltage (+ V <sub>BE</sub> = 1 V)	-V <sub>CEX</sub>	max.	30	50	V
Collector-emitter voltage (open base)	-VCEO	max.	30	45	V
Collector current (peak value)	I <sub>CM</sub>	max.	200	200	mΑ
Total power dissipation up to $T_{amb} = 60  {}^{\circ}\mathrm{C}$	$P_{tot}$	max.	200	200	m₩
Junction temperature	$\tau_{i}$	max.	150	150	oC
Small-signal current gain $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; f = 1 \text{ kHz}$	h <sub>fe</sub>	> <	125 900	125 900	
Transition frequency $-I_C = 10 \text{ mA; } -V_{CE} = 5 \text{ V}$ Noise figure at $R_s = 2 \text{ k}\Omega$	fŢ	typ.	150	150	MHz
$-I_C = 200 \mu\text{A}; -V_{CE} = 5 \text{V}$ f = 30 Hz to 15 kHz	F	typ.	1,2 4	1 3	dB dB
f = 1 kHz; B = 200 Hz	F	<	4	4	dB

#### **MECHANICAL DATA** Dimensions in mni Marking code 3,0 Fig. 1 SOT-23. BC859A = 4A2,8 B = 4BВ 1.9 C = 4C0,150 BC860A = 4E0.090 0,95 0,2(M) A B B = 4FA C = 4GBC859AR = 4AR0,1 10° max BR = 4BRmáx 1.4 2,5 max CR = 4CR10° BC860AR = 4ER ∓ max BR = 4FR3 CR = 4GR\_1,1 \_max 0.1(M) A B 3ò° max TOP VIEW 7266908.9

R-types are available on request

Limiting values in accordance with the Absolute Maximum System (IEC 134)

•	,		BC859	BC860	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	30	50	٧
Collector-emitter voltage (+ V <sub>BE</sub> = 1 V)	-V <sub>CEX</sub>	max.	30	50	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30	45	٧
Emitter-base voltage (open collector)	$-V_{CBO}$	max.	5	5	V
Collector current (d.c.)	-I <sub>C</sub>	max.	10	00	mA
Collector current (peak value)	-I <sub>CM</sub>	max.	20	00	mA
Emitter current (peak value)	IEM	max.	20	00	mA
Base current (peak value)	-I <sub>BM</sub>	max.	20	00	mA
Total power dissipation up to $T_{amb} = 60  {}^{\circ}C^{**}$	P <sub>tot</sub>	max.	. 20	00	mW
Storage temperature	T <sub>stg</sub>		-65 to + 15	50	oC
Junction temperature	Tj	max.	15	50	oC
THERMAL CHARACTERISTICS* $T_{j} = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab	R <sub>th j-t</sub>	=	(	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	= "	28	30	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	= '	(	90	K/W
CHARACTERISTICS					
$T_j = 25$ °C unless otherwise specified					
Collector cut-off current				_	
$I_E = 0; -V_{CB} = 30 \text{ V}; T_j = 25 ^{\circ}\text{C}$	-I <sub>CBO</sub>	typ.		1 15	nA nA
T <sub>j</sub> = 150 °C	-Ісво	<		4	μΑ
Base-emitter voltage ▲					
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	-V <sub>BE</sub>	typ.	690 to 75	50 50	mV mV
$-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	$-V_{BE}$	<	82		mV

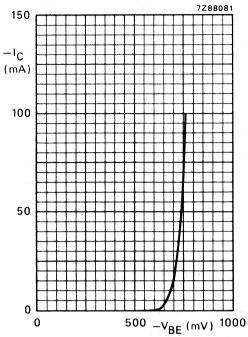
<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

<sup>▲ -</sup>VBE decreases by about 2 mV/K with increasing temperature.

	Saturation voltages*						
	$-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ mA}$	-V <sub>CEsat</sub>	typ.		75 00	mV mV	
		$-V_{BEsat}$	typ.		00	mV	
	$-I_C = 100 \text{ mA}; -I_B = 5 \text{ mA}$	-V <sub>CEsat</sub>	typ.		50 50	mV	
	u u	-V <sub>BEsat</sub>	typ.		50 50	mV mV	
	Collector capacitance at f = 1 MHz						
	$I_E = I_e = 0; -V_{CB} = 10 \text{ V}$	$C_{\mathbf{c}}$	typ.	4	1,5	pF	
	Transition frequency at f = 35 MHz						
	$-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	fT	typ.	1!	50	MHz	
	Small-signal current gain at f = 1 kHz						
	$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	h <sub>fe</sub>		125 to 90	00		
\	Noise figure at $R_S = 2 k\Omega$						
	$-I_C = 200 \mu\text{A}; -V_{CE} = 5 \text{V}$			BC859	BC860		
	f = 30 Hz to 15 kHz	F	typ.	1,2 4	1 3	dB dB	
	f = 1 kHz; B = 200 Hz	F	typ.	1 4	1 4	dB dB	
	Equivalent noise voltage at $R_S = 2 k\Omega$						
	$-I_C = 200 \mu A; -V_{CE} = 5 V$ f = 10 Hz to 50 Hz; $T_{amb} = 25  {}^{\circ}C$	V <sub>n</sub>	<	. <del>-</del>	0,11	μV	
	D.C. current gain						
	$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; \text{ total range}$	hFE		125 to 80			
	A selections B selections	h <sub>FE</sub> h <sub>FE</sub>		125 to 25 220 to 47			
	C selections	hFE		420 to 80			

 $<sup>^{*}</sup>$   $-V_{\mbox{\footnotesize{BEsat}}}$  decreases by about 1,7 mV/K with increasing temperature.



10<sup>3</sup> typ. behaviour -V<sub>CE</sub> = 5 V -I<sub>C</sub> = 50 mA -I<sub>C</sub> = 50 mA -I<sub>C</sub> = 50 mA -I<sub>C</sub> = 10 Fig. 3 Typical values.  $-V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \text{ °C}$ .

Fig. 4 Typical values.

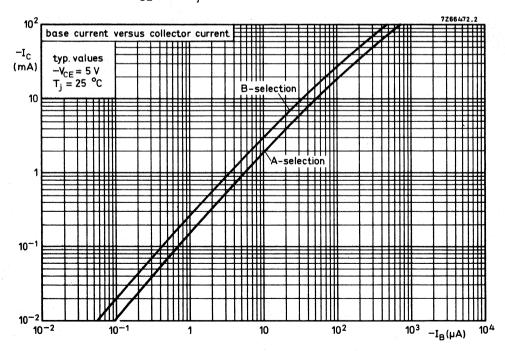


Fig. 5.

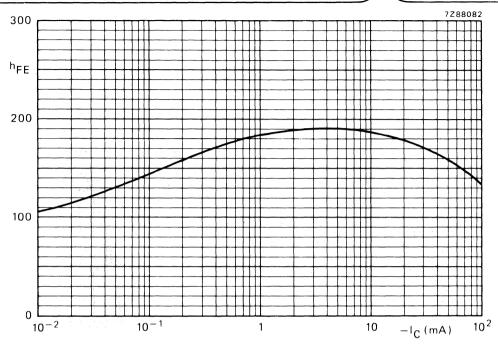


Fig. 6 Typical values. D.C. current gain A-selections.  $-V_{CE}$  = 5 V;  $T_{j}$  = 25 °C.

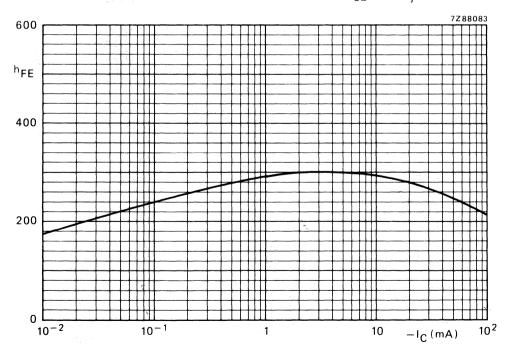


Fig. 7 Typical values. D.C. current gain B-selections.  $-V_{CE} = 5 \text{ V}$ ;  $T_i = 25 \text{ }^{\circ}\text{C}$ .

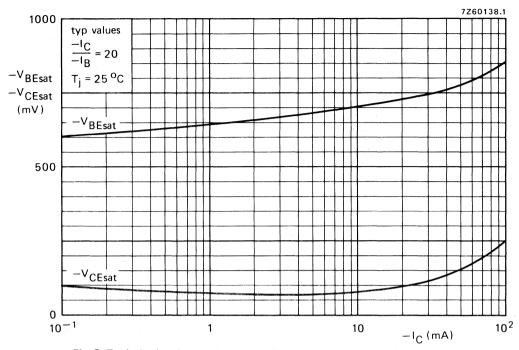


Fig. 8 Typical values base-emitter and collector-emitter saturation voltage.

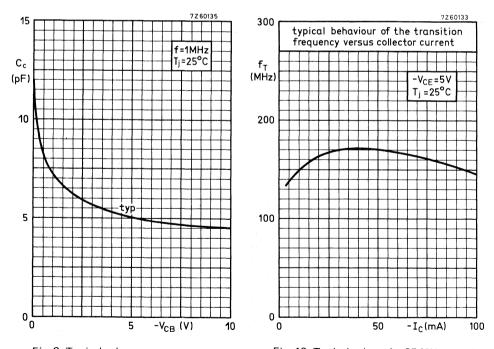


Fig. 9 Typical values.

Fig. 10 Typical values. f = 35 MHz.

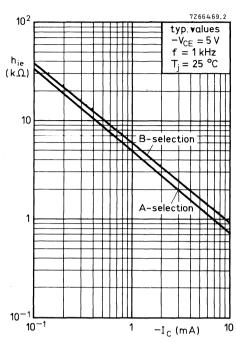


Fig. 11 Typical values.

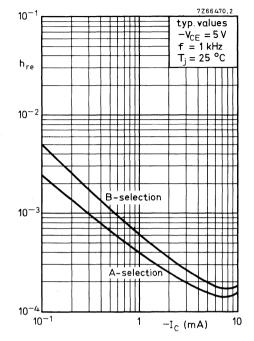


Fig. 12 Typical values.

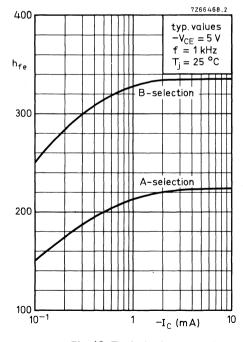


Fig. 13 Typical values.

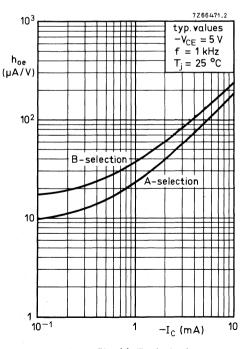


Fig. 14 Typical values.

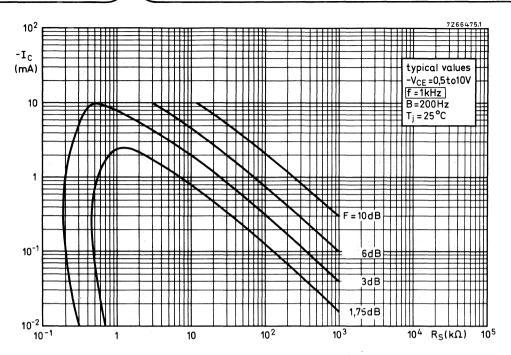


Fig. 15 Curves of constant noise figure at f = 1 kHz.

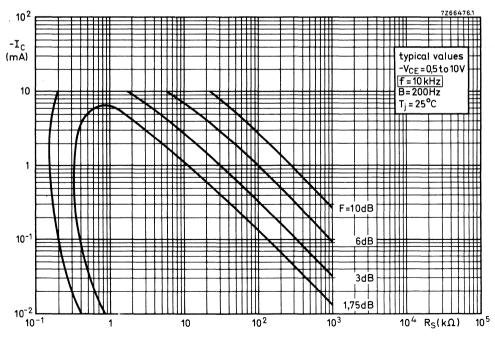


Fig. 16 Curves of constant noise figure at f = 10 kHz.

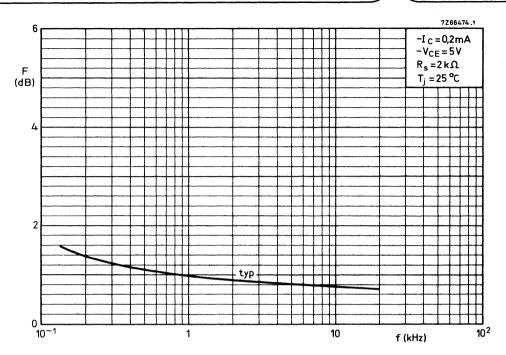


Fig. 17 Typical values noise figure.

## SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a microminiature plastic envelope intended for low-voltage, high-current I.f. applications. BC868/BC869 is the matched complementary pair suitable for class-B audio output stages up to 3 W.

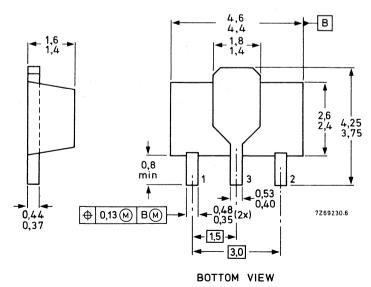
#### **QUICK REFERENCE DATA**

Collector-emitter voltage (V <sub>BE</sub> = 0)	V <sub>CES</sub>	max.	25 \	/
Collector-emitter voltage (open base)	$v_{CEO}$	max.	20 \	/
Collector current (peak value)	<sup>I</sup> CM	max.	2 A	4
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	1 V	V
Junction temperature	Τį	max.	150 C	C
D.C. current gain $I_C = 500 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	85 to	375	
Transition frequency at f = 35 MHz $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	60 N	ИHz

**MECHANICAL DATA** 

Dimensions in mm Fig. 1 SOT-89.

Mark CAC





RATINGS				
Limiting values in accordance with the Absolute Maximum System	n (IEC 134)			
Collector-emitter voltage (V <sub>BE</sub> = 0)	V <sub>CES</sub>	max.	25	V
Collector-emitter voltage (open base)	V <sub>CEO</sub>	max.	20	V
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.	5	V
Collector current (d.c.)	Ic	max.	1	A
Collector current (peak value)	I <sub>CM</sub>	max.	2	Α
Base current (d.c.)	IB	max.	100	mΑ
Base current (peak value)	IBM	max.	200	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	1	W
Storage temperature	T <sub>stg</sub>	-65 to +	150	oC
Junction temperature	$T_{j}$	max.	150	oC
THERMAL RESISTANCE				
From junction to ambient in free air*	R <sub>th j-a</sub>	= 1	125	K/W
From junction to tab	R <sub>th j-t</sub>	=	10	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0$ ; $V_{CB} = 25 \text{ V}$	I <sub>CBO</sub>	<	10	μΑ
$I_E = 0$ ; $V_{CB} = 25 \text{ V}$ ; $T_j = 150 ^{\circ}\text{C}$	I <sub>CBO</sub>	<	1	mA
Emitter cut-off current				_
$I_C = 0$ ; $V_{EB} = 5 V$	IEBO	<	10	μΑ
Base-emitter voltage IC = 5 mA; VCE = 10 V	V <sub>BE</sub>	typ.	0.62	V
I <sub>C</sub> = 1 A; V <sub>CE</sub> = 1 V		< ·	, -	V
Collector-emitter saturation voltage	V <sub>BE</sub>		•	•
I <sub>C</sub> = 1 A; I <sub>B</sub> = 100 mA	V <sub>CEsat</sub>	<	0,5	٧
D.C. current gain				
$I_C = 5 \text{ mA}; V_{CE} = 10 \text{ V}$	hFE	>	50	
$I_C = 500 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	PE	85 to		
I <sub>C</sub> = 1 A; V <sub>CE</sub> = 1 V	pEE	>	60	
Collector capacitance at f = 450 kHz	<u> </u>	tum	27	nE
$I_E = I_e = 0; V_{CB} = 5 V$	Cc	typ.	21	pF
Transition frequency at f = 35 MHz IC = 10 mA; VCE = 5 V	fT	typ.	60	MHz
	'1	cyp.	00	141112

<sup>\*</sup> Mounted on a ceramic substrate, area = 2,5 cm²; thickness = 0,7 mm.

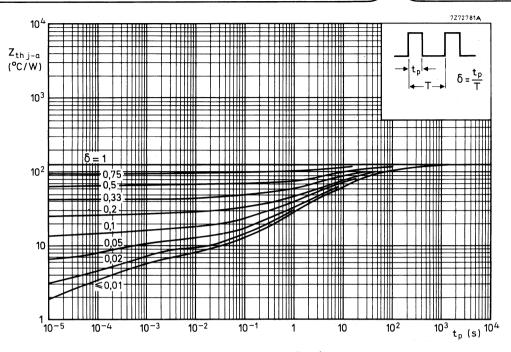


Fig. 2 Pulse power rating chart.

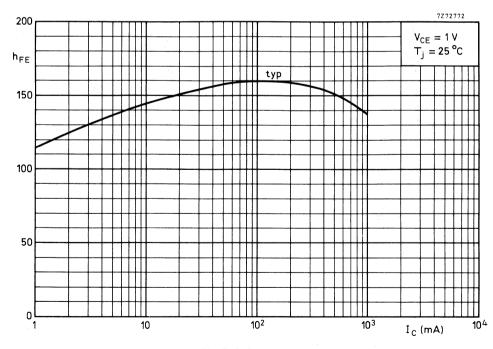


Fig. 3 D.C. current gain.

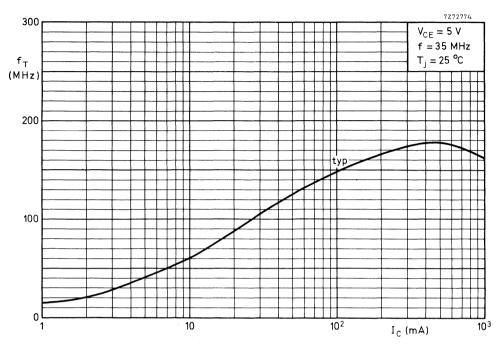


Fig. 4 Typical values transition frequency as a function of collector current.

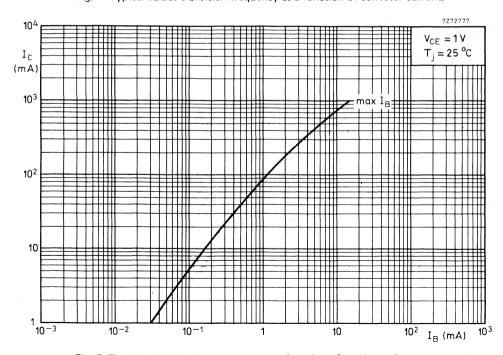


Fig. 5 Typical values collector current as a function of maximum base current.

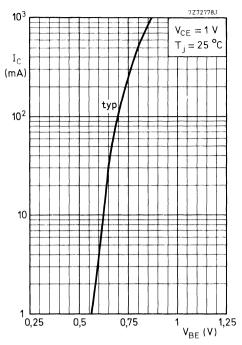


Fig. 6 Typical values collector current as a function of base-emitter voltage.

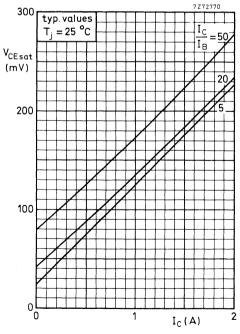


Fig. 7 Collector-emitter saturation voltage as a function of collector current.

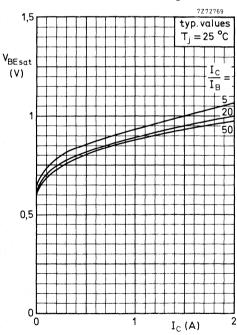


Fig. 8 Base-emitter saturation voltage as a function of collector current.

## SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a plastic microminiature envelope, intended for low-voltage, high-current l.f. applications. BC868/BC869 is the matched complementary pair suitable for class-B audio output stages up to 3 W.

#### **QUICK REFERENCE DATA**

Collector-emitter voltage (VBE = 0)	-V <sub>CES</sub>	max.	25	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	20	V
Collector current (peak value)	<sup>−l</sup> CM	max.	2	Α
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	1	W
Junction temperature	Тj	max.	150	oC
D.C. current gain $-I_C = 500 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	85 to	375	
Transition frequency at $f = 35 \text{ MHz}$ $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	60	MHz

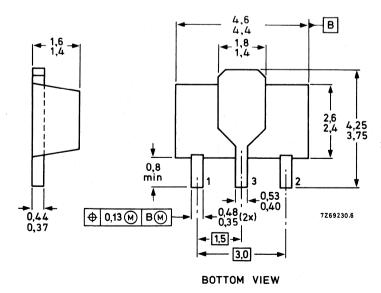
**MECHANICAL DATA** 

Fig. 1 SOT-89.

Dimensions in mm

Mark

CEC





RATINGS					
Limiting values in accordance with the Absolute Maximum	System	(IEC 134)			
Collector-emitter voltage (V <sub>BE</sub> = 0)		-V <sub>CES</sub>	max.	25	V
Collector-emitter voltage (open base)		-VCEO	max.	20	V
Emitter-base voltage (open collector)		-V <sub>EBO</sub>	max.	5	V
Collector current (d.c.)		-IC	max.	1	Α
Collector current (peak value)		-ICM	max.	2	Α
Base current (d.c.)		−I <sub>B</sub>	max.	100	mA
Base current (peak value)		-I <sub>BM</sub>	max.	200	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C*		P <sub>tot</sub>	max.	1	W
Storage temperature		$T_{stg}$	-65 to +	150	оС
Junction temperature		Тj	max.	150	οС
THERMAL RESISTANCE					
From junction to ambient in free air*		R <sub>th j-a</sub>	=	125	K/W
From junction to tab		R <sub>th j-t</sub>	=	10	K/W
CHARACTERISTICS					
T <sub>j</sub> = 25 °C unless otherwise specified					
Collector cut-off current					
$I_E = 0; -V_{CB} = 25 \text{ V}$		-ICBO	<		μΑ
$I_E = 0; -V_{CB} = 25 V; T_j = 150 °C$		-ICBO	<	1	mA
Emitter cut-off current I <sub>C</sub> = 0; -V <sub>EB</sub> = 5 V		-I <sub>EBO</sub>	<	10	μΑ
Base-emitter voltage					
$-1_{C} = 5 \text{ mA}; -V_{CE} = 10 \text{ V}.$		-V <sub>BE</sub>	• •	0,62	
$-I_C = 1 A; -V_{CE} = 1 V$		-VBE	<	1	V
Collector-emitter saturation voltage -I <sub>C</sub> = 1 A; -I <sub>B</sub> = 100 mA		-V <sub>CEsat</sub>	<	0,5	V
D.C. current gain					
$-I_C = 5 \text{ mA}; -V_{CE} = 10 \text{ V}$		hFE	> 05.4	50	
$-I_C = 500 \text{ mA}; -V_{CE} = 1 \text{ V}$		hFE	85 to		
$-I_C = 1 A; -V_{CE} = 1 V$		hFE	>	60	
Collector capacitance at f = 450 kHz I <sub>E</sub> = I <sub>e</sub> = 0; -V <sub>CB</sub> = 5 V		C <sub>c</sub>	typ.	45	pF
Transition frequency at f = 35 MHz -IC = 10 mA; -VCE = 5 V		fT	typ.	60	MHz

<sup>\*</sup> Mounted on a ceramic substrate, area = 2,5 cm²; thickness = 0,7 mm.

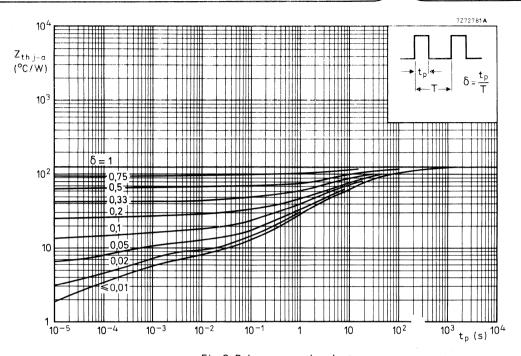


Fig. 2 Pulse power rating chart.

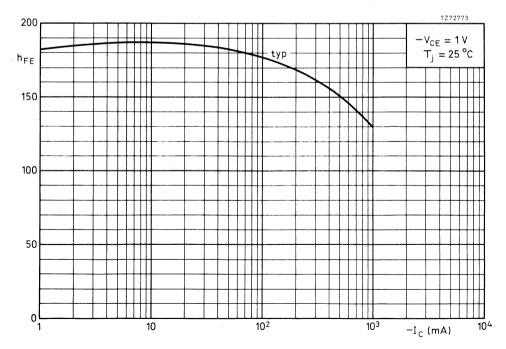


Fig. 3 D.C. current gain.

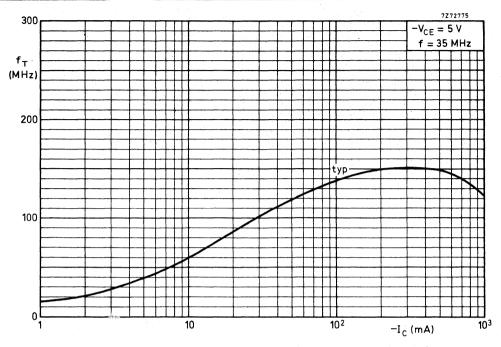


Fig. 4 Typical values transition frequency as a function of collector current.

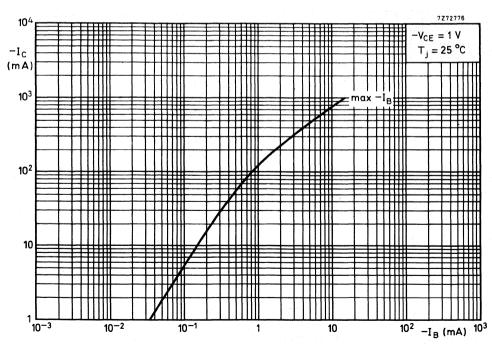


Fig. 5 Typical values collector current as a function of maximum base current.

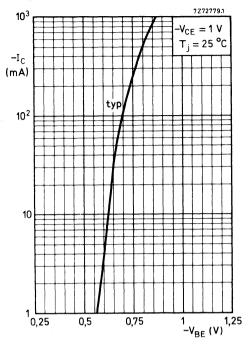


Fig. 6 Typical values collector current as a function of base-emitter voltage.

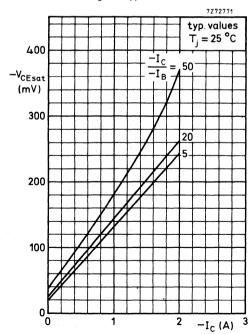


Fig. 7 Collector-emitter saturation voltage as a function of collector current.

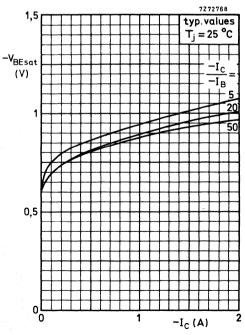


Fig. 8 Base-emitter saturation voltage as a function of collector current.



# SILICON PLANAR EPITAXIAL TRANSISTORS

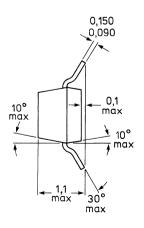
P-N-P transistors, in a microminiature plastic envelope, intended for low level, low noise general purpose applications in thick and thin-film circuits.

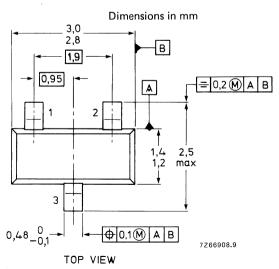
#### QUICK REFERENCE DATA

			BCF29	BCF30	_
D.C. current gain at $T_j = 25$ °C $-I_C = 2$ mA; $-V_{CE} = 5$ V	hFE	> <	120 260	215 500	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	3	2	V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	3	2	V
Collector current (peak value)	$-I_{CM}$	max.	200		mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	35	0	mW
Junction temperature	$T_{j}$	max.	17	5	oC
Transition frequency at f = 35 MHz -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 5 V	f <sub>T</sub>	typ.	15	0	MHz
Noise figure at R <sub>S</sub> = 2 k $\Omega$ $-I_C$ = 200 $\mu$ A; $-V_{CE}$ = 5 V; f = 1 kHz; B = 200 Hz	F	<		4	dB

#### **MECHANICAL DATA**

Fig. 1 SOT-23.





BCF29 = C7 BCF30 = C8

Marking code

BCF29R = C77 BCF30R = C9

1—(1)

R-types are available on request.

Limiting values in accordance with the Absolute Maximu	ım System (IEC	134)		
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	32	٧
Collector-emitter voltage (V <sub>BE</sub> = 0)	$-v_{CES}$	max.	32	V
Collector-emitter voltage (open base)				
$-I_C = 2 \text{ mA}$	-v <sub>CEO</sub>	max.	32	V
Emitter-base voltage (open collector)	$-v_{EBO}$	max.	5	V
Collector current (d.c.)	-I <sub>C</sub>	max.	100	mΑ
Collector current (peak value)	<sup>−l</sup> cM	max.	200	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C**	P <sub>tot</sub>	max.	350	mW
Storage temperature	$T_{stg}$		-65 to + 175	oC
Junction temperature	Тj	max.	175	oC
THERMAL CHARACTERISTICS *				
$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	==	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	= :	280	K/W
From soldering points to ambient**	$R_{ths-a}$	=	90	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0; -V_{CB} = 32 \text{ V}$	-Ісво	<	100	nΑ
$I_E = 0$ ; $-V_{CB} = 32 \text{ V}$ ; $T_i = 100 ^{\circ}\text{C}$	-Ісво	<	10	μΑ
Base-emitter voltage				
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	$-v_BE$		600 to 750	mV
Saturation voltages			. :	
	-V <sub>CEsat</sub>	typ.	300	mV mV
$-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ mA}$	-V <sub>BEsat</sub>	typ.	720	
			150	
$-I_C = 50 \text{ mV}; -I_B = 2.5 \text{ mA}$	−V <sub>CEsat</sub> −V <sub>BEsat</sub>	typ.	810	
	DESGL	- / 1~ •	2.0	•

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain		BCF29	BCF30	<u> </u>	
$-I_C = 10 \mu\text{A}; -V_{CE} = 5 \text{V}$	hFE	typ. 90	150	).	
$-1_{C} = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	hFE	> 120 < 260	215 500		
Collector capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0; -V_{CB} = 10 \text{ V}$	$C_{\mathbf{c}}$	typ.	4,5	pF	•
Transition frequency at f = 35 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f <sub>T</sub>	typ.	150	MHz	
Noise figure at R <sub>S</sub> = $2 k\Omega$ $-I_C = 200 \mu A$ ; $-V_{CE} = 5 V$ f = $1 kHz$ ; B = $200 Hz$	F	< typ.	4 1	dB dB	

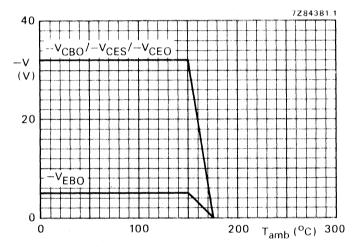


Fig. 2 Voltage derating curves.

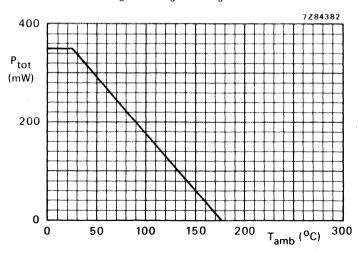


Fig. 3 Power derating curve.

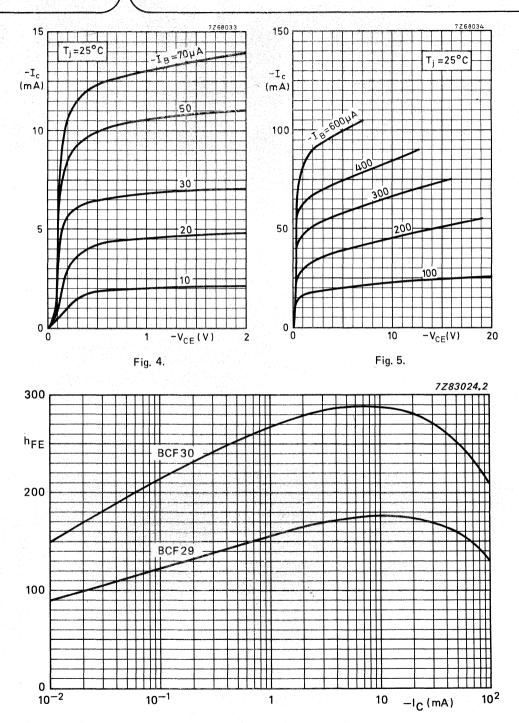
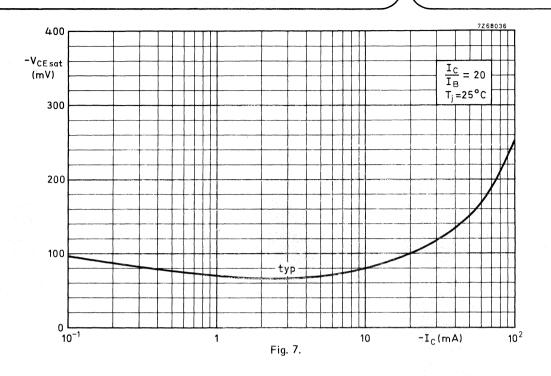
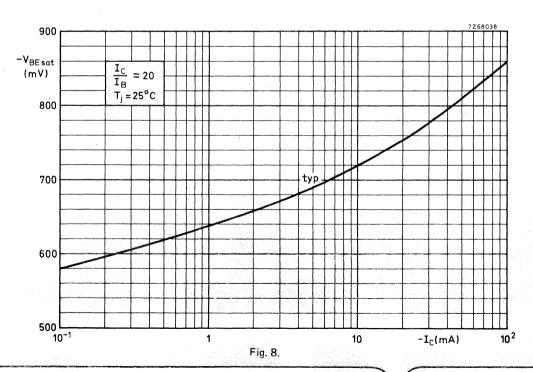


Fig. 6 Typical values of d.c. current gain.  $-V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \text{ }^{o}\text{C}$ .

BCF29 BCF30





BCF29 BCF30

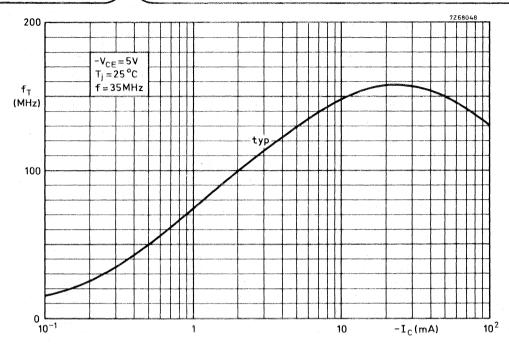


Fig. 9.

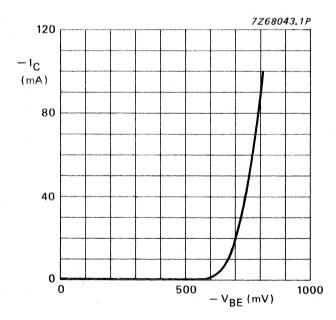
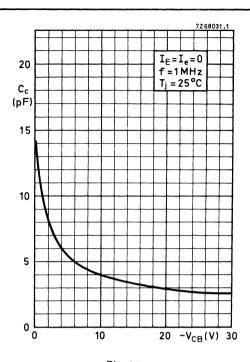


Fig. 10  $-V_{CE} = 5 \text{ V; T}_j = 25 \text{ °C; typical values.}$ 



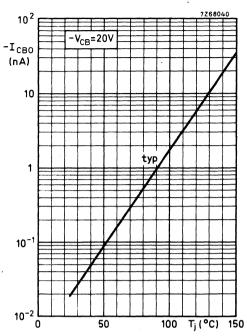


Fig. 11.

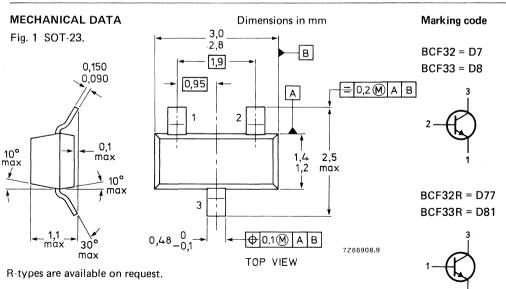
Fig. 12.

# SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic envelope. They are intended for low level, low noise general purpose applications in thick and thin-film circuits.

### **QUICK REFERENCE DATA**

			BCF32	BCF3	3
D.C. current gain at $T_j = 25$ °C $I_C = 2$ mA; $V_{CE} = 5$ V	hFE	> <	200 450	420 800	_
Collector-base voltage (open emitter)	$v_{CBO}$	max.	3	2	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	3:	2	V
Collector current (peak value)	<sup>I</sup> CM	max.	20	0	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	35	0	mW
Junction temperature	$T_{j}$	max.	17	5	oC
Transition frequency at f = 35 MHz $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	30	0	MHz
Noise figure at R <sub>S</sub> = $2 \text{ k}\Omega$ I <sub>C</sub> = $200 \mu\text{A}$ ; V <sub>CE</sub> = $5 \text{ V}$ ; f = $1 \text{ kHz}$ ; B = $200 \text{ Hz}$	F	<		4	dB



RATINGS		
Limiting values in accordance with the Absolute Maximum S	System (IEC 134)	
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max. 32 V
Collector-emitter voltage (open base) IC = 2 mA	V <sub>CEO</sub>	max. 32 V
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max. 5 V
Collector current (d.c.)	Ic	max. 100 mA
Collector current (peak value)	ICM	max. 200 mA
Total power dissipatation up to Tamb = 25 °C**	P <sub>tot</sub>	max. 350 mW
Storage temperature	T <sub>stg</sub>	-65 to + 175 °C
Junction temperature	T <sub>j</sub>	max. 175 °C
THERMAL CHARACTERISTICS*	• •	
$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$		
Thermal resistance		
From junction to tab	R <sub>th j-t</sub>	= 50 K/W
From tab to soldering points	R <sub>th t-s</sub>	= 280 K/W
From soldering points to ambient**	R <sub>ths-a</sub>	= 90 K/W
CHARACTERISTICS		
T <sub>i</sub> = 25 °C unless otherwise specified		
Collector cut-off current		
$I_E = 0$ ; $V_{CB} = 32 \text{ V}$	СВО	< 100 nA
$I_E = 0$ ; $V_{CB} = 32 \text{ V}$ ; $T_j = 100 ^{\circ}\text{C}$	СВО	< 10 μΑ
Base-emitter voltage I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V	V <sub>BE</sub>	550 to 700 mV
Saturation voltages		typ. 120 mV
$I_C = 10 \text{ mA}; I_B = 0.5 \text{ mA}$	VCEsat	< 250 mV
I <sub>C</sub> = 50 mA; I <sub>B</sub> = 2,5 mA	V <sub>BEsat</sub> V <sub>CEsat</sub>	typ. 750 mV typ. 210 mV

850 mV

typ.

**VBEsat** 

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.

D.C. current gain		В	CF32	BCF33	
$I_C = 10  \mu A;  V_{CE} = 5  V$	hFE	typ.	150	270	
		>	200	420	
$I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	hFE	<	450	800	
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0$ ; $V_{CB} = 10 \text{ V}$	, C <sub>c</sub>	typ.	2,5	5 pF	, <sup>1</sup> -
Transition frequency at f = 35 MHz					
$I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	fΤ	typ.	300	) MHz	
Noise figure at $R_S = 2 k\Omega$					
$I_C = 200  \mu A;  V_{CE} = 5  V$		_		1 dB	
f = 1 kHz; B = 200 Hz	F	typ.		dB 2 dB	
		-71	. ,-		

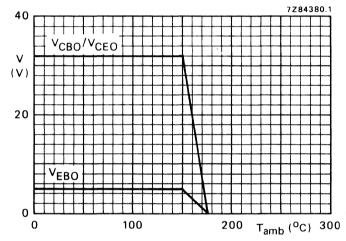


Fig. 2 Voltage derating curves.

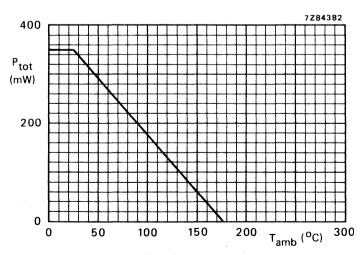
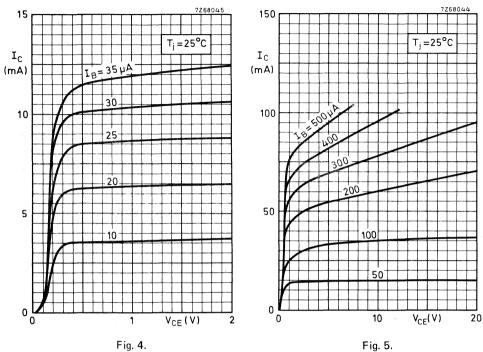


Fig. 3 Power derating curve.



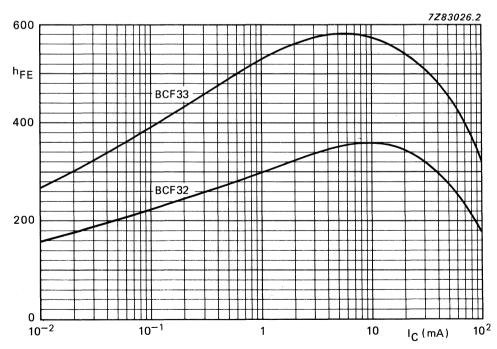


Fig. 6 Typical values d.c. current gain.  $V_{CE}$  = 5 V;  $T_j$  = 25 °C.

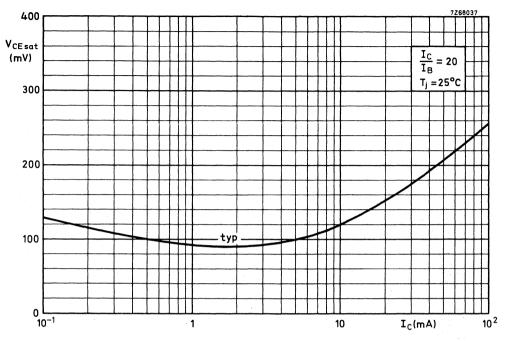


Fig. 7.

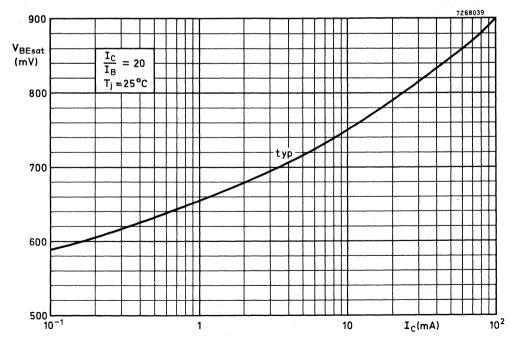
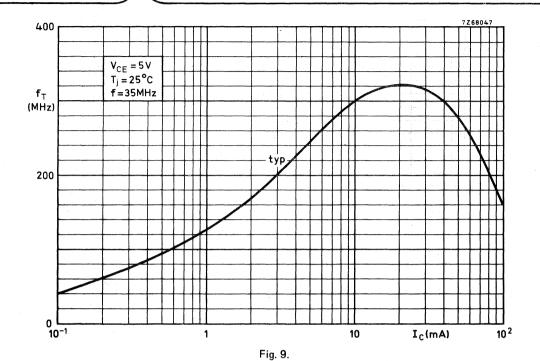


Fig. 8.



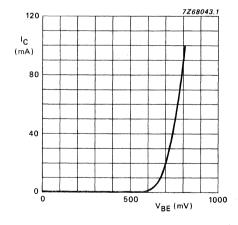
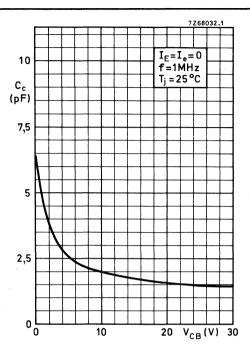


Fig. 10  $V_{CE}$  = 5 V;  $T_j$  = 25 °C; typical values.



10<sup>3</sup>

Fig. 11.

Fig. 12.

# SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors, in a microminiature plastic envelope, intended for low level, low noise applications in thick and thin-film circuits.

### QUICK REFERENCE DATA

D.C. current gain at $T_j = 25$ °C $-1_C = 2$ mA; $-V_{CE} = 5$ V	hFE	> <	215 500
Collector-base voltage (open emitter)	-v <sub>cbo</sub>	max.	50 V
Collector-emitter voltage (open base)	-VCEO	max.	45 V
Collector current (peak value)	-I <sub>CM</sub>	max.	200 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	350 mW
Junction temperature	Ťį	max.	175 °C
Transition frequency at $f = 35 \text{ MHz}$ $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	150 MHz
Noise figure at $R_S = 2 k\Omega$ $-I_C = 200 \mu A$ ; $-V_{CE} = 5 V$ ; f = 1 kHz; $B = 200 Hz$	F	<	4 dB

#### **MECHANICAL DATA** Marking code Dimensions in mm Fig. 1 SOT-23. 3,0 2,8 BCF70 = H7 В 1,9 0,150 0.090 0.95 = 0,2 M A B Α 0,1 10° max 1,4 máx 2,5 máx <u>₹</u> 10° BCF70R = H71 3 ф 0,1M 3Ò° 7266908.9 max TOP VIEW

R-types are available on request.

Limiting values in accordance with the Absolute Maximum System	n (IEC 134)			
Collector-base voltage (open emitter) see Fig. 2	-V <sub>CBO</sub>	max.	50	V
Collector-emitter voltage (V <sub>BE</sub> = 0) see Fig. 2	-V <sub>CES</sub>	max.	50	V
Collector-emitter voltage (open base) see Fig. 2				
$-I_C = 2 \text{ mA}$	-VCEO	max.	45	
Emitter-base voltage (open collector) see Fig. 2	-VEBO	max.	5	V
Collector current (d.c.)	-IC	max.	100	mΑ
Collector current (peak value)	-ICM	max.	200	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C**	P <sub>tot</sub>	max.	350	mW
Storage temperature	T <sub>stg</sub>	-65 to +	175	oC
Junction temperature	$T_{j}$	max.	175	oC
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	=	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
$I_E = 0$ ; $-V_{CB} = 20 \text{ V}$ ; $T_j = 25 \text{ °C}$ $T_j = 100 \text{ °C}$	-I <sub>CBO</sub>	< <	100	
	-ICBO	<	10	μΑ
Base-emitter voltage $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; T_i = 25 \text{ °C}$	-\/	600 to	750	m\/
Saturation voltages	-V <sub>BE</sub>	000 10	/50	111 V
$-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ mA}$	-V <sub>CEsat</sub>	typ.		mV
	CLSat	<	300	mV

−V<sub>BEsat</sub> −V<sub>CEsat</sub> −V<sub>BEsat</sub>

typ.

typ.

typ.

720 mV

150 mV 810 mV

 $-I_C = 50 \text{ mA}; -I_B = 2.5 \text{ mA}$ 

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain				
$-I_C = 10 \mu A; -V_{CE} = 5 V$	hFE	typ.	150	
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	hFE	> <	215 500	
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0; -V_{CB} = 10 \text{ V}$	$C_{\mathbf{c}}$	typ.	4,5 pF	-
Transition frequency at f = 35 MHz				
$-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	fŢ	typ.	150 MHz	
Noise figure at R <sub>S</sub> = 2 k $\Omega$				
$-1_{C} = 200 \mu\text{A}; -V_{CE} = 5 \text{V}$	_	· < <	4 dB	
f = 1 kHz; B = 200 Hz	F	typ.	1 dB	

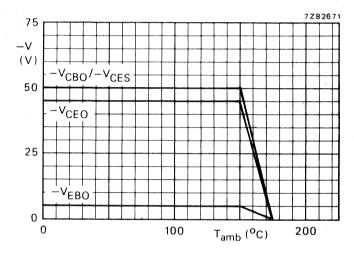


Fig. 2 Voltage derating curves.

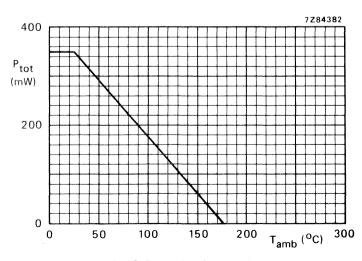


Fig. 3 Power derating curve.

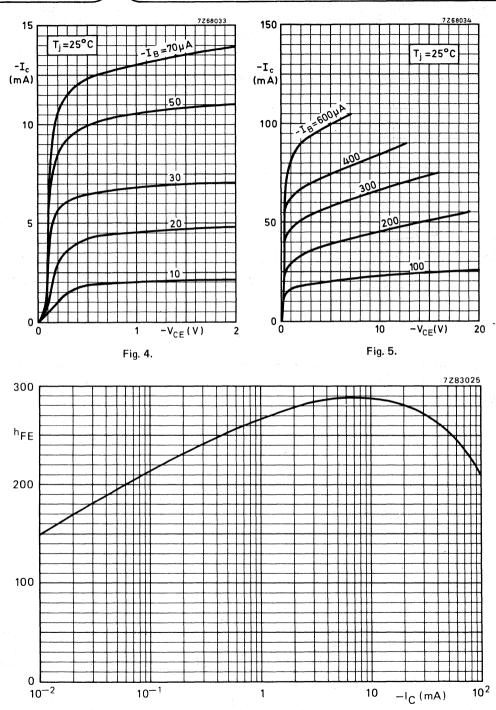


Fig. 6 Typical values of d.c. current gain.  $-V_{CE}$  = 5 V;  $T_j$  = 25 °C.

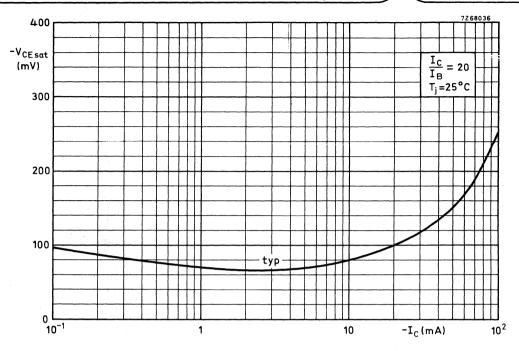


Fig. 7.

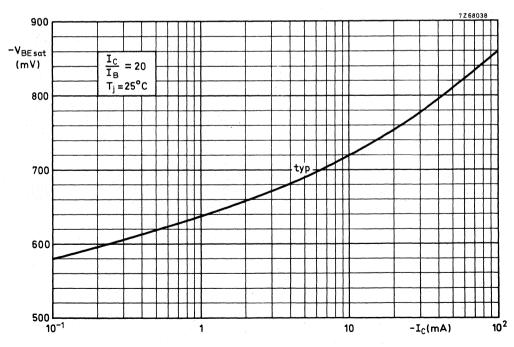


Fig. 8.

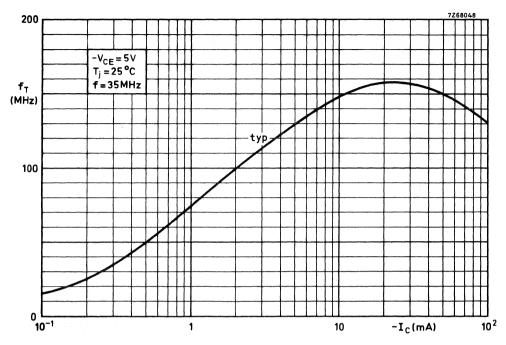


Fig. 9.

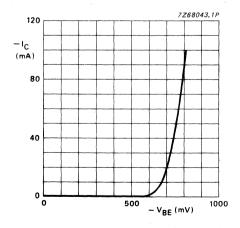
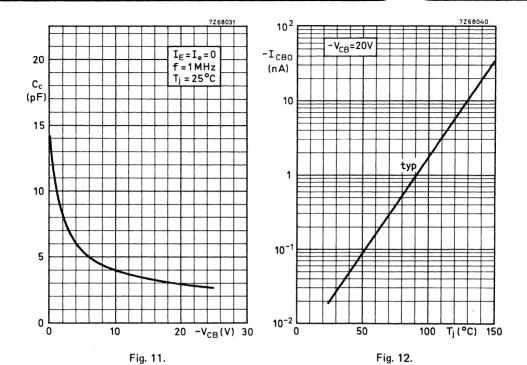


Fig. 10  $-V_{CE}$  = 5 V;  $T_j$  = 25 °C; typical values.



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# SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors, in a microminiature plastic envelope, intended for low level, low noise general purpose applications in thick and thin-film circuits.

### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$v_{CBO}$	max.	50 V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	45 V
Collector current (peak value)	ICM	max.	200 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350 mW
Junction temperature	Тj	max.	175 °C
D.C. current gain at $T_j = 25$ °C $I_C = 2$ mA; $V_{CE} = 5$ V	hFE	> <	420 800
Transition frequency at $f = 35 \text{ MHz}$ I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 5 V	f <sub>T</sub>	typ.	300 MHz
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CE</sub> = 5 V; f = 1 kHz; B = 200 Hz	F	<	4 dB

#### MECHANICAL DATA Dimensions in mm Marking code Fig. 1 SOT-23. BCF81 = K9 3,0 2,8 В 1,9 0,150 0,090 0,95 = 0,2 (M) A B Α 2 0,1 10° max max 2,5 max BCF81R = K91 ₹ 10° → max 3 \_1,1 \_max **⊕** 0,1(M) '3ò° 7Z66908.9 max TOP VIEW

R-types are available on request See also *Soldering recommendations*.

NATINGS				
Limiting values in accordance with the Absolute Maximum System (	IEC 134)			
Collector-base voltage (open emitter) see Fig. 2	V <sub>CBO</sub>	max.	50	<b>V</b>
Collector-emitter voltage (open base) see Fig. 2				
$I_C = 2 \text{ mA}$	VCEO	max.	45	V
Emitter-base voltage (open collector) see Fig. 2	VEBO	max.	5	V
Collector current (d.c.)	l <sub>C</sub>	max.	100	mΑ
Collector current (peak value)	<sup>I</sup> CM	max.	200	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C**	P <sub>tot</sub>	max.	350	mW
Storage temperature	T <sub>stq</sub>	-65 to +	175	oC
Junction temperature	Tj	max.	175	oC
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	=	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>ths-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$	Ісво	<	100	nΑ
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$ ; $T_j = 100 \text{ °C}$	ГСВО	<	10	μΑ
Base emitter voltage				
$I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	$V_{BE}$	550 to	700	mV
Saturation voltages		typ.	120	mV
$I_C = 10 \text{ mA}; I_B = 0.5 \text{ mA}$	V <sub>CEsat</sub>	<	250	mV
	<b>V</b> BEsat	typ.	750	mV
$I_C = 50 \text{ mA}; I_B = 2.5 \text{ mA}$	V <sub>CEsat</sub>	typ.	210	
	V <sub>BEsat</sub>	typ.	850	m v

<sup>\*</sup> See Thermal characteristics.
\*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V	hFE	> <	420 800
Collector capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0$ ; $V_{CB} = 10 \text{ V}$	$C_{\mathbf{c}}$	typ.	2,5 pF <b>←</b>
Transition frequency at $f = 35 \text{ MHz}$ I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 5 V	f <sub>T</sub>	typ.	300 MHz
Noise figure at R <sub>S</sub> = $2 k\Omega$ I <sub>C</sub> = $200 \mu$ A; V <sub>CE</sub> = $5 V$ f = $1 kHz$ ; B = $200 Hz$	F	< typ.	4 dB 1,2 dB

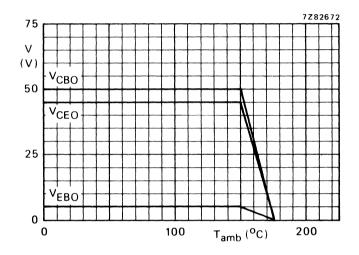


Fig. 2 Voltage derating curves.

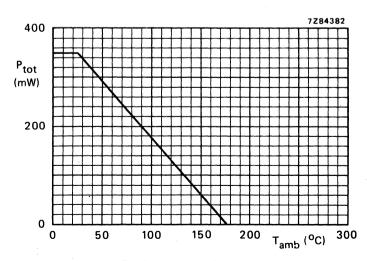


Fig. 3 Power derating curve.



# SILICON PLANAR DARLINGTON TRANSISTOR

P-N-P silicon planar Darlington transistor in a plastic SOT-23 envelope. N-P-N complement is BCV27.

### **QUICK REFERENCE DATA**

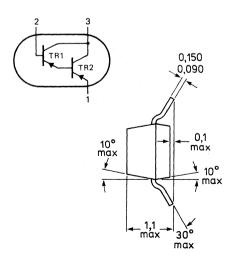
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30	V
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40	V
Collector current	$-I_{\mathbb{C}}$	max.	300	mΑ
Junction temperature	$T_{j}$	max.	150	оС
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	350	mW
Collector-emitter saturation voltage $-I_C = 100 \text{ mA}; -I_B = 0.1 \text{ mA}$ D.C. current gain	-V <sub>CEsat</sub>	max.	1	V
-I <sub>C</sub> = 1 mA; -V <sub>CE</sub> = 5 V -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 5 V -I <sub>C</sub> = 100 mA; -V <sub>CE</sub> = 5 V	hFE hFE hFE	> > >	4 000 10 000 20 000	
Transition frequency at $f = 100 \text{ MHz}$ $-1_C = 30 \text{ mA}; -V_{CE} = 5 \text{ V}$	f <sub>T</sub>		220	MHz

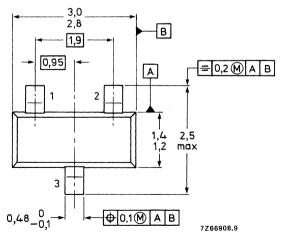
### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm

Marking: FD





TOP VIEW

RATINGS				
Limiting values in accordance with the Absolute Maximum System	n (IEC 134)			
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30	V
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40	V
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	10	٧
Collector current	-Ic	max.	300	mΑ
Collector current (peak value)	-I <sub>CM</sub>	max.	800	mΑ
Base current	-IB	max.	100	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	350	mW
Storage temperature	$\boldsymbol{T_S} = \{\boldsymbol{S}_{\boldsymbol{S}}^{S_{\boldsymbol{S}}}, \boldsymbol{S}_{\boldsymbol{S}}^{S_{\boldsymbol{S}}}, \boldsymbol{S}_{\boldsymbol{S}}^{S_{\boldsymbol{S}}}, \boldsymbol{S}_{\boldsymbol{S}}^{S_{\boldsymbol{S}}}\}$	-65 to	+ 150	oC .
Junction temperature	$\tau_j$ , where $\gamma_{i_1}$	max.	150	oC
THERMAL RESISTANCE				
From junction to ambient*	R <sub>th j-a</sub>	max.	350	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise stated				
Collector-base current				
-V <sub>CBO</sub> = 30 V	-ICBO	max.	100	nA
Emitter-base current -VEB = 10 V	-I <sub>EBO</sub>	max.	100	nA
Collector-emitter breakdown voltage -I <sub>C</sub> = 10 mA	V/221050	min.	30	V
Collector-base breakdown voltage	-V(BR)CEO		90	•
-I <sub>C</sub> = 10 μA	-V(BR)CBO	min.	40	٧
Emitter-base breakdown voltage				
-I <sub>E</sub> = 100 nA	−V(BR)EBO	min.	10	V
Collector-emitter saturation voltage $-I_C = 100 \text{ mA}; -I_B = 0,1 \text{ mA}$	-V <sub>CEsat</sub>	max.	1	٧
Base-emitter saturation voltage $-I_C = 100 \text{ mA}$ ; $-I_B = 0.1 \text{ mA}$	-V <sub>BEsat</sub>	max.	1,5	V
D.C. current gain				
$-I_C = 1 \text{ mA}; -V_{CE} = 5 \text{ V}$ $-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	p==	>	4 000 10 000	
-IC = 100 mA; -VCE = 5 V	hFE hFE	>	20 000	
Transition frequency at f = 100 MHz				
$-I_C = 30 \text{ mA}; -V_{CE} = 5 \text{ V}$	fŢ	typ.	220	MHz
Collector capacitance at f = 1 MHz	_			
$I_E = 0; -V_{CB} = 30 \text{ V}$	C <sub>C</sub>	typ.	3,5	p⊢

<sup>\*</sup> Mounted on a ceramic substrate of 15 mm  $\times$  15 mm  $\times$  0,7 mm.

# SILICON PLANAR DARLINGTON TRANSISTOR

N-P-N silicon planar Darlington transistor in a plastic SOT-23 envelope. P-N-P complement is BCV26.

### QUICK REFERENCE DATA

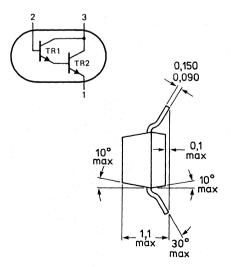
Collector-emitter voltage (open base)	VCEO	max.	30	٧
Collector-base voltage (open emitter)	$V_{CBO}$	max.	40	٧
Collector current	Ic	max.	300	mΑ
Junction temperature	Ti	max.	150	οС
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	350	mW
Collector-emitter saturation voltage IC = 100 mA; IB = 0,1 mA	V <sub>CEsat</sub>	max.	1	V
D.C. current gain $I_{C} = 1 \text{ mA}; V_{CE} = 5 \text{ V}$ $I_{C} = 10 \text{ mA}; V_{CE} = 5 \text{ V}$ $I_{C} = 100 \text{ mA}; V_{CE} = 5 \text{ V}$	hFE hFE hFE	> > > > > > > > > > > > > > > > > > > >	4 000 10 000 20 000	
Transition frequency at $f = 100 \text{ MHz}$ $I_C = 30 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	220	MHz

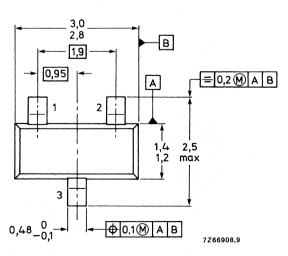
### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm

Marking: FF





TOP VIEW

RATINGS				
Limiting values in accordance with the Absolute Maximum System	(IEC 134)			
Collector-emitter voltage (open base)	VCEO	max.	30	V
Collector-base voltage (open emitter)	V <sub>СВО</sub>	max.	40	V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	10	V
Collector current	IC	max.	300	mΑ
Collector current (peak value)	<sup>1</sup> CM	max.	800	mA
Base current	I <sub>B</sub>	max.	100	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	350	mW
Storage temperature	T <sub>s</sub>	65 to	0 + 150	oC :
Junction temperature	т <sub>і</sub> ч	max.	150	оС
THERMAL RESISTANCE	,			
From junction to ambient*	R <sub>th j-a</sub>	max.	350	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise stated				
Collector-base current				
$V_{CBO} = 30 \text{ V}$	ICBO	max.	100	nΑ
Emitter-base current				
$V_{EB} = 10 \text{ V}$	<sup>I</sup> EBO	max.	100	nA
Collector-emitter breakdown voltage $I_C = 10 \text{ mA}$	V(BR)CEO	min.	30	V
Collector-base breakdown voltage $I_C = 10 \mu A$	V <sub>(BR)</sub> CBO	min.	40	V
Emitter-base breakdown voltage	(BIT/CBO			
I <sub>E</sub> = 100 nA	V <sub>(BR)EBO</sub>	min.	10	V
Collector-emitter saturation voltage				
$I_C = 100 \text{ mA}; I_B = 0.1 \text{ mA}$	$V_{CEsat}$	max.	1	V
Base-emitter saturation voltage $I_C = 100 \text{ mA}$ ; $I_B = 0.1 \text{ mA}$	V.		1.5	.,
D.C. current gain	V <sub>BEsat</sub>	max.	1,5	V
$I_C = 1 \text{ mA}; V_{CE} = 5 \text{ V}$	hFE	>	4 000	
$I_{C} = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	hFE	>	10 000	
$I_C = 100 \text{ mA}; V_{CE} = 5 \text{ V}$	hFE	>	20 000	
Transition frequency at f = 100 MHz	_			
$I_C = 30 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	fΤ	typ.	220	MHz
Collector capacitance at f = 1 MHz	C		2 -	
$I_E = 0$ ; $V_{CB} = 30 \text{ V}$	$C_c$	typ.	3,5	p⊦

 $<sup>^{\</sup>ast}$  Mounted on a ceramic substrate of 15 mm x 15 mm x 0,7 mm.

# SILICON PLANAR EPITAXIAL TRANSISTOR

Double n-p-n transistor, in SQT-143 plastic envelope, designed for use in applications where the working point must be independent of temperature.

Owing to application of two similar crystals of one slice this device has a good thermal coupling and  $V_{BE}$  matching. Special interconnection of the two transistor crystals allows the device to be used as a current mirror and the separated emitter leads allow connection to different sources.

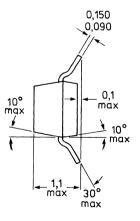
A similar device in p-n-p configuration is the BCV62.

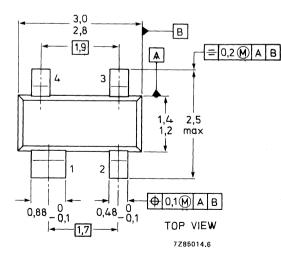
### QUICK REFERENCE DATA

Collector-emitter voltage (open base)			
regarding transistor T1	$V_{CEO}$	max.	30 V
Collector-base voltage (open emitter)			
regarding transistor T1	V <sub>CB</sub> Q	max.	30 V
Collector current			
d.c.	1C	max.	100 mA
peak	ICM	max.	200 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	300 mW
Junction temperature	$T_{j}$	max.	150 °C

#### **MECHANICAL DATA**

Fig. 1 SOT-143.





Dimensions in mm

# Marking code:

BCV61 : D91 BCV61A: D92 BCV61B: D93 BCV61C: D94



7 **Z 8 7 6** 2 9

Limiting values in accordance with the Absolute Maximum System	m (IEC 134)			
Collector-emitter voltage (open base)				
regarding transistor T1	VCEO	max.	30	٧
Collector-base voltage (open emitter) regarding transistor T1	V <sub>CBO</sub>	max.	30	V
Base current (transistor T1)				
peak value	<sup>1</sup> ВМ1	max.		mΑ
Emitter-base voltage	VEBS	max.	6	V
Collector current				
d.c.	IC	max.		mA
peak	ICM	max.	200	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C when mounted on a ceramic substrate of				
8 mm x 10 mm x 0,7 mm	P <sub>tot</sub>	max.	300	mW
Junction temperature	T <sub>i</sub>	max.	150	
Storage temperature	T <sub>stg</sub>	65 to -		
otorage temperature	' stg	-05 (0	130	- 0
THERMAL RESISTANCE				
Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm				
from junction to ambient	R <sub>th j-a</sub>	=	430	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Transistor T1				
Collector cut-off current				
$I_E = 0$ ; $V_{CB} = 30 \text{ V}$	ІСВО	< -		nA
I <sub>E</sub> = 0; V <sub>CB</sub> = 30 V; T <sub>j</sub> = 150 °C	.000	< , ,	5	μΑ
Base-emitter voltage IC = 2 mA; VCE = 5 V	Vac	typ.	660	mV*
	VBE	580 to	700	mV*
$I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	VBE	<	770	mV*
Saturation voltages		typ.	۵n	mV
$I_{C} = 10 \text{ mA}$ ; $I_{B} = 0.5 \text{ mA}$	VCEsat	τ <b>γ</b> ρ.	250	
	V <sub>BEsat</sub>	typ.		mV**
1 100 1 5		typ.	200	
$I_C = 100 \text{ mA}; I_B = 5 \text{ mA}$	VCEsat	<	600	
	<b>VBEsat</b>	typ.	900	mV**

Decreasing 2 mV/°C with increasing temperature.
 Decreasing 1,7 mV/°C with increasing temperature.

Transition frequency at f = 35 MHz					
I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 5 V		fT	typ.	300	MHz
Collector capacitance at $f = 1 \text{ MHz}$ $IE = i_e = 0$ ; $V_{CB} = 10 \text{ V}$		C <sub>c</sub>	typ.	2,5	pF
Noise figure at R <sub>S</sub> = $2 \text{ k}\Omega$ I <sub>C</sub> = $200 \mu\text{A}$ ; V <sub>CE</sub> = $5 \text{ V}$ f = $1 \text{ kHz}$ ; B = $200 \text{ Hz}$		F	typ.	2 10	dB dB
D.C. current gain $I_C = 100 \ \mu\text{A}; \ V_{CE} = 5 \ \text{V}$ $I_C = 2 \ \text{mA}; \ V_{CE} = 5 \ \text{V}$		hFE hFE	> 110 to	100 800	
Input impedance $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 1 \text{ kHz}$		h <sub>ie</sub>	typ.	5	kΩ
Reverse voltage transfer ratio $IC = 2 \text{ mA}$ ; $VCE = 5 \text{ V}$ ; $f = 1 \text{ kHz}$		h <sub>re</sub>	typ. 2 x	10-4	
Small signal current gain IC = 2 mA; VCE = 5 V; f = 1 kHz		h <sub>fe</sub>	100 to	900	
Output admittance IC = 2 mA; VCE = 5 V; f = 1 kHz		h <sub>oe</sub>	typ.	30	μS
Transistor T2					
Base-emitter forward voltage $IE = 250 \text{ mA}$ $IE = 10 \mu \text{A}$		VBES	<pre></pre>	1,8 400	
Matching of transistor T1 and transistor T2  at IE2 = 0,5 mA and V <sub>CE1</sub> = 5 V  T <sub>amb</sub> = 25 °C  T <sub>amb</sub> = 150 °C		I <sub>C1</sub> /I <sub>C2</sub> I <sub>C1</sub> /I <sub>C2</sub>	0,7 to 0,7 to		
Thermal coupling of transistor T1 and Transisto T1: VCE = 5 V Maximum current for thermal	r T2*	101/102	0,7 10	, 1,3	
stability of IC1		IE2	typ.		mA ·
D.C. current gain $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	BCV61A	hFE	min. typ. max.	110 180 220	
	BCV61B	hFE	min. typ. max.	200 290 450	
	BCV61C	hFE	min. typ. max.	420 520 800	

<sup>\*</sup> Without emitter resistor and device mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm. (See Fig. 2)

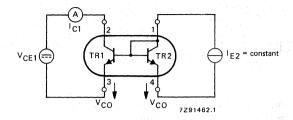


Fig. 2 Test circuit current matching.

Note: Voltage drop at contacts:  $V_{CO} < \frac{2}{3} \ U_{\mbox{\scriptsize T}} \triangleq 16 \ \mbox{mV}.$ 

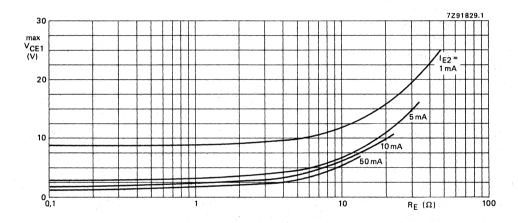


Fig. 3 Characteristic for determination of max.  $V_{CE1}$  at specified R<sub>E</sub> range with I<sub>E2</sub> as parameter under condition of  $\frac{I_{C1}}{I_{E2}} = 1,3$  (see Fig. 4).

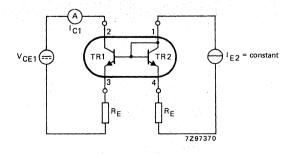


Fig. 4 BCV61 with emitter resistors.

# SILICON PLANAR EPITAXIAL TRANSISTOR

Double p-n-p transistor, in SOT-143 plastic envelope, designed for use in applications where the working point must be independent of temperature.

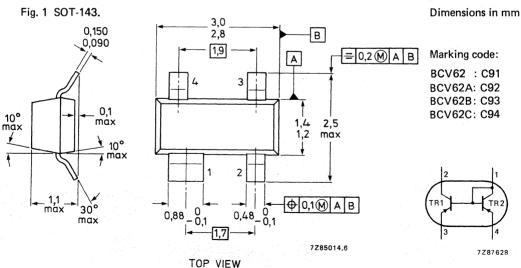
Owing to application of two similar crystals of one slice this device has a good thermal coupling and  $V_{BE}$  matching. Special interconnection of the two transistor crystals allows the device to be used as a current mirror and the separated emitter leads allow connection to different sources.

A similar device in n-p-n configuration is the BCV61.

#### QUICK REFERENCE DATA

Collector-emitter voltage (open base) regarding transistor T1	-V <sub>CEO</sub>	max	30 V
Collector-base voltage (open emitter) regarding transistor T1	-V <sub>CBO</sub>	max.	30 V
Collector current d.c.	-1 <sub>C</sub>	max.	100 mA
peak	-I <sub>CM</sub>	max.	200 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	300 mW
Junction temperature	Tj	max.	150 °C

### **MECHANICAL DATA**



Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (open base) regarding transistor T1	-V <sub>CEO</sub>	max. 30 V
Collector-base voltage (open emitter)		
regarding transistor T1	-V <sub>CBO</sub>	max. 30 V
Base current (transistor T1)		
peak value	<sup>−1</sup> BM1	max. 200 mA
Emitter-base voltage	$-V_{EBS}$	max. 6 V
Collector current		
d.c.	-IC	max. 100 mA
peak	−¹CM	max. 200 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C when mounted on a ceramic substrate of		
8 mm x 10 mm x 0,7 mm	P <sub>tot</sub>	max. 300 mW
Junction temperature	$T_{i}$	max. 150 °C
Storage temperature	T <sub>stg</sub>	-65 to +150 °C
THERMAL RESISTANCE		
Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm		
from junction to ambient	R <sub>th j-a</sub>	= 430 K/W
CHARACTERISTICS		
T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified		
Transistor T1		

Collector cut-off current  $-I_E = 0$ ;  $-V_{CB} = 30 \text{ V}$ 15 nA -Ісво  $-I_E = 0$ ;  $-V_{CB} = 30 \text{ V}$ ;  $T_i = 150 \text{ °C}$ < 5 μA Base-emitter voltage typ. 650 mV\*  $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$  $-V_{BE}$ 600 to 750 mV\*  $-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$  $-V_{BE}$ 820 mV\* < Saturation voltages 75 mV typ.  $-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ mA}$  $-V_{CEsat}$ 300 mV <  $-V_{\mathsf{BEsat}}$ 700 mV\*\* typ. typ. 250 mV  $-I_C = 100 \text{ mA}; -I_B = 5 \text{ mA}$ -V<sub>CEsat</sub> < 650 mV

-V<sub>BEsat</sub>

typ.

850 mV\*\*

Decreasing 2 mV/°C with increasing temperature.

Decreasing 1,7 mV/°C with increasing temperature.

Transition frequency at f = 35 MHz			r		450 8411
$-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$			fΤ	typ.	150 MHz
Collector capacitance at $f = 1 \text{ MHz}$ $I_E = i_e = 0$ ; $-V_{CB} = 10 \text{ V}$			C <sub>c</sub>	typ.	4,5 pF
Noise figure at R <sub>S</sub> = 2 k $\Omega$ -I <sub>C</sub> = 200 $\mu$ A; -V <sub>CE</sub> = 5 V			F	typ.	2 dB
f = 1 kHz; B = 200 Hz			F	<	10 dB
D.C. current gain					
$-I_C = 100 \mu A; -V_{CE} = 5 V$			hFE	>	100
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$			hFE	100	to 800
Input impedance					
-I <sub>C</sub> = 2 mA; -V <sub>CE</sub> = 5 V; f = 1 kHz			h <sub>ie</sub>	typ.	<b>3</b> kΩ
Reverse voltage transfer ratio					
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; f = 1 \text{ kHz}$			h <sub>re</sub>	typ. 3	x 10 <sup>-4</sup>
Small signal current gain					
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; f = 1 \text{ kHz}$			h <sub>fe</sub>	100	to 900
Output admittance					_
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; f = 1 \text{ kHz}$			h <sub>oe</sub>	typ.	50 μS
Transistor T2					
Base-emitter forward voltage					
$-I_{E} = 250 \text{ mA}$			-V <sub>BES</sub>	<	1,5 V
$-I_E = 10 \mu\text{A}$			*BES	>	400 mV
Matching of transistor T1 and transistor at $I_{E2} = 0.5$ mA and $V_{CE1} = 5$ V	T2				
T <sub>amb</sub> = 25 °C			IC1/IC2	0,7 to 1	,3
T <sub>amb</sub> = 150 °C			C1/IC2	0,7 to 1	,3
Thermal coupling of transistor T1 and tr	anaistar T	O*	01 02	,	•
T1: -VCE = 5 V	ansistor i	2			
Maximum current for thermal					
stability of $-I_{C1}$			I <sub>E2</sub>	typ.	5 mA
D.C. current gain				min.	125
		BCV62A	hFE	typ.	180
				max.	250
		DOV/60D		min.	220
		BCV62B	hFE	typ. max.	290 475
				min.	420
		BCV62C	hFF	typ.	520
			1 6	max.	800

<sup>\*</sup> Without emitter resistor and device mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm. (see Fig. 2)

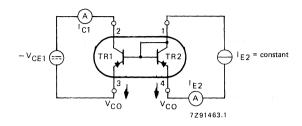


Fig. 2 Test circuit current matching.

Note: Voltage drop at contacts:  $V_{CO}<\frac{2}{3}$  UT  $\triangleq$  16 mV.

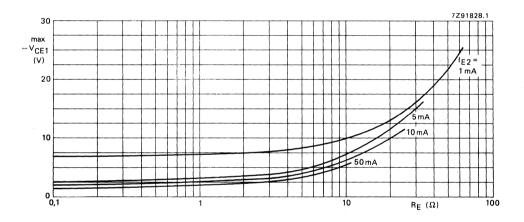


Fig. 3 Characteristic for determination of max.  $V_{CE1}$  at specified R<sub>E</sub> range with I<sub>E2</sub> as parameter under condition of  $\frac{I_{C1}}{I_{E2}}$  = 1,3 (see Fig. 4).

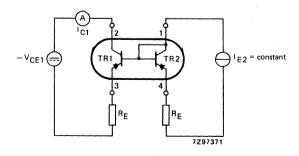


Fig. 4 BCV62 with emitter resistors.

This data sheet contains advance information and specifications are subject to change without notice.

## SILICON PLANAR TRANSISTOR

Double N-P-N transistor in a plastic SOT-143 envelope. Intended for Schmitt-trigger applications. P-N-P complement is the BCV64.

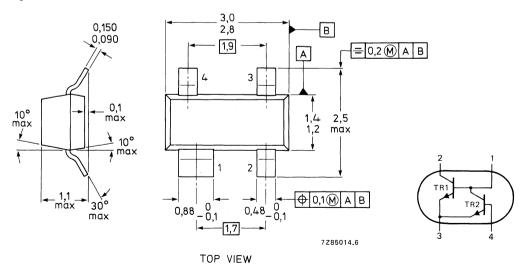
#### **QUICK REFERENCE DATA**

	transisto	r 	T1	T2	
Collector-emitter voltage (open base)	$v_{CEO}$	max.	30	6	V
Collector-base voltage (open emitter)	$V_{CBO}$	max.	30	6	V
Collector current	Ic	max.	10	0	mΑ
Junction temperature	Τj	max.	15	0	oC
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	30	0	mW
Collector-emitter saturation voltage $I_C = 10 \text{ mA}$ ; $I_B = 0.5 \text{ mA}$	VCEsat	max.	30	0	mV
Small signal current gain	h <sub>fe</sub>		100 to	900	
Transition frequency at f = 35 MHz IC = 10 mA; VCE = 5 V	fŢ	typ.	200	_	MHz

#### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOT-143.



Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (open base)	VCEO	max.	30	6 V
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	30	6 V
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.	6	V
Collector current (d.c.)	1 <sub>C</sub>	max.	100	mA
Collector current (peak value)	ICM	max.	200	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	300	mW
Storage temperature	Ts		-65 to	+150 °C
Junction temperature	$T_{j}$	max.	150	oC
THERMAL RESISTANCE				
From junction to ambient*	R <sub>th j-a</sub>	max.	430	K/W
CHARACTERISTICS				
Tamb = 25 °C unless otherwise stated				
	transisto	r	T1	T2
Collector cut-off current IE = 0; VCBO = 30 V	ІСВО	max.	15	15 nA
I <sub>E</sub> = 0; V <sub>CBO</sub> = 30 V T <sub>j</sub> = 150 °C	ІСВО	max.	5	5 μΑ
Saturation voltage**				
$I_C = 10 \text{ mA}; I_B = 0.5 \text{ mA}$	VCEsat	typ.	75	75 mV
	V <sub>CEsat</sub> V <sub>BEsat</sub>	max. typ.	300 700	300 mV 700 mV
I <sub>C</sub> = 100 mA; I <sub>B</sub> = 5 mA	VCEsat	typ.	250	250 mV
	VCEsat	max.	650	_ mV
	V <sub>BEsat</sub>	typ.	850	_ mV
Base-emitter voltage ▲				
I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V	V <sub>BE</sub>	min. typ.	600 650	– mV – mV
	VBE	max.	750	– mV
IC = 10 mA; VCE = 5 V	VBE	max.	820	- mV
IC = 2 mA; VCE = 700 mV	V <sub>BE</sub>	typ.		700 mV
Collector capacitance at f = 1 MHz				
$I_E = I_e = 0$ ; $V_{CE} = 10 \text{ V}$	C <sub>C</sub>	typ.	4	– pF
Transition frequency at $f = 35 \text{ MHz}$ IC = 10 mA; VCE = 5 V	fr	typ.	200	– MHz
			1	

transistor

<sup>\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

<sup>\*\*</sup> VBEsat decreases by approx 1,7 mV/K with increasing temperature.

<sup>▲ -</sup>VBE decreases by about 2 mV/K with increasing temperature.

Small signal current gain at f = 1 kHz

I<sub>C</sub> = 2 mA; T1 : V<sub>CE</sub> = 5 V T2 : V<sub>CE</sub> = 700 mV Transistor 1

D.C. current gain I<sub>C</sub> = 2 mA; V<sub>CE</sub> = 5 V

100 to 900 hfe BCV 63 Α В С 110 110 200 420 min. 180 290 520 hFE typ. 800 220 450 800 max.

Transistor 2

D.C. current gain

IC = 2 mA; VCE = 700 mV

Group selection will be done on T1. Due to matched crystals  $h_{FE}$  values for T2 are the same as T1.

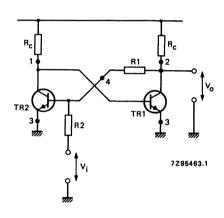


Fig. 2 Schmitt-trigger application.



This data sheet contains advance information and specifications are subject to change without notice.

# SILICON PLANAR TRANSISTOR

Double P-N-P transistor in a plastic SOT-143 envelope. Intended for Schmitt-trigger applications. N-P-N complement is the BCV63.

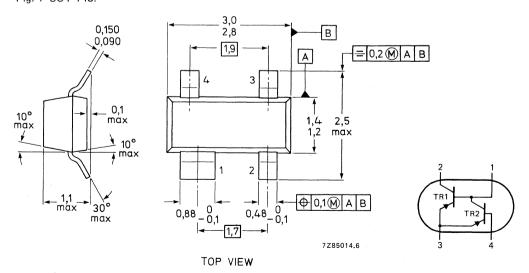
#### QUICK REFERENCE DATA

	transistor	T1	T2
Collector-emitter voltage (open base)	-V <sub>CEO</sub> max	. 30	6 V
Collector-base voltage (open emitter)	−V <sub>CBO</sub> max	30	6 V
Collector current	−I <sub>C</sub> max	10	00 mA
Junction temperature	T <sub>j</sub> max	. 15	50 °C
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub> max	c. / 30	00 mW
Collector-emitter saturation voltage $-I_C = 10 \text{ mA}$ ; $-I_B = 0.5 \text{ mA}$	-V <sub>CEsat</sub> max	c. 30	00 mV
Small signal current gain	h <sub>fe</sub>	100 to	900
Transition frequency at f = 35 MHz $-I_C = 10 \text{ mA; } -V_{CE} = 5 \text{ V}$	f <sub>T</sub> typ.	200	— MHz

#### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOT-143.



Limiting values in accordance with the Absolute Maximum System (IEC 134)

	transistor		T1	T2	-
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	6	V
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	30	6	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	6	6	V
Collector current (d.c.)	-IC	max.		6	mΑ
Collector current (peak value)	-ICM	max.	20	0	mΑ
Total power dissipation up to $T_{amb} = 25  {}^{\circ}\text{C*}$	P <sub>tot</sub>	max.	30	0	mW
Storage temperature	Ts		-65 to	+150	oC
Junction temperature	$T_j$	max.	15	0	oC
THERMAL RESISTANCE				*	
From junction to ambient*	R <sub>th j-a</sub>	max.	43	0	K/W
CHARACTERISTICS					
T <sub>amb</sub> = 25 °C unless otherwise stated					
	transistor		T1	T2	_
Collector cut-off current -IE = 0; -VCBO = 30 V	-I <sub>CBO</sub>	max.	15	15	nA
$-I_E = 0$ ; $-V_{CBO} = 30 V$ $T_j = 150  {}^{\circ}\text{C}$	-Ісво	max.	5	5	μΑ
Saturation voltage**					
$-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ mA}$	-VCEsat		75 300	75 300	mV
	-VCEsat -VBEsat		700	700	
-I <sub>C</sub> = 100 mA; -I <sub>B</sub> = 5 mA	-VCEsat -VCEsat -VBEsat	typ. max.	250 650 850	250 _ _	mV mV mV
Base-emitter voltage ▲	DESGE				
$-1_{C} = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	-VBE	typ.	650 600/750		mV mV
$-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	$-V_{BE}$	max.	820		mV
$-I_C = 2 \text{ mA}; -V_{CE} = 700 \text{ mV}$	-VBE	typ.		700	mV
Collector capacitance at f = 1 MHz $-I_E = i_e = 0$ ; $-V_{CE} = 10 V$	Cc	typ.	4	<b>-</b> ,	pF
Transition frequency at f = 35 MHz -IC = 10 mA; -VCE = 5 V	fŢ	typ.	200	<del>-</del>	MHz

Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

 $V_{\mbox{\footnotesize{BE}}\mbox{\footnotesize{sat}}} \mbox{ decreases by approx 1,7 mV/K with increasing temperature.} \\ -V_{\mbox{\footnotesize{BE}}} \mbox{ decreases by about 2 mV/K with increasing temperature.}$ 

100 to 900

Small signal current gain at f = 1 kHz

Transistor 1

D.C. current gain

$$-I_C = 2 \text{ mA; } -V_{CE} = 5 \text{ V}$$

**BCV** 64 Α В Ċ 420 min. 110 125 220 180 290 520 hFE typ. 475 800 800 250 max.

hfe

Transistor 2

D.C. current gain

$$-I_C = 2 \text{ mA}; -V_{CE} = 700 \text{ mV}$$

Group selection will be done on T1. Due to matched crystals  $h_{FE}$  values for T2 are the same as T1.

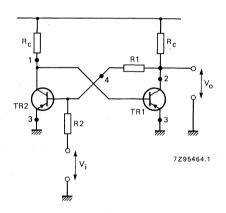


Fig. 2 Schmitt-trigger application.

# DEVELOPMENT DATA

This data sheet contains advance information and specifications are subject to change without notice.

# SILICON PLANAR TRANSISTORS

A pair of two matched P-N-P and N-P-N crystals, based on the BC857 and BC847, in a microminiature SOT-143 envelope.

Complementary crystals give advantages in P.C.B. layout using S.M.D. technology.

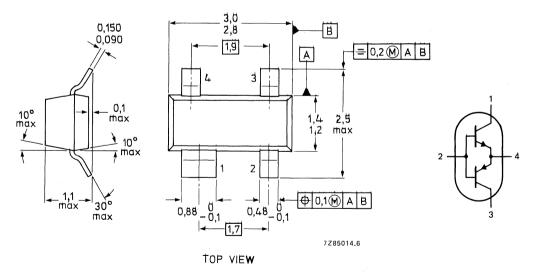
#### QUICK REFERENCE DATA

Collector-emitter voltage (open base)	VCEO	max.	30 V
Collector-base voltage (open emitter)	<b>VCBO</b>	max.	30 V
Collector current	IC	max.	100 mA
Collector current (peak value)	ICM	max.	200 mA
Total power dissipation up to $T_{amb} = 25$ °C	P <sub>tot</sub>	max.	300 mW
Junction temperature	† <sub>j</sub>	max.	150 °C

#### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOT-143.



Limiting values in accordance with the Absolute Maximum System (IEC 134)

D	A	
rer	transistor:	

Ter transfer.				
Collector-emitter voltage (open base)	V <sub>CEO</sub>	max.	30	V
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	30	V
Collector current	ic	max.	100	mΑ
Collector current (peak value)	ICM	max.	200	mΑ
Total power dissipation (per device) up to $T_{amb} = 25$ °C	P <sub>tot</sub>	max.	300	mW
Storage temperature	$T_S$	-65 to +	150	οС
Junction temperature	$T_{j}$	max.	150	οС
THERMAL RESISTANCE				
From junction to ambient*	R <sub>th j-a</sub>	max.	430	K/W
CHARACTERISTICS				
Per transistor:				
T <sub>j</sub> = 25 °C unless otherwise stated				
Collector cut-off current  I <sub>E</sub> = 0; V <sub>CB</sub> = 30 V  I <sub>E</sub> = 0; V <sub>CB</sub> = 30 V	ICBO	max.	15	nA
$T_j = 150$ °C	I <sub>СВО</sub>	max.	5	μΑ
Base-emitter voltage**  IC = 2 mA; VCE = 5 V	V <sub>BE</sub>	typ. 580 to	650 750	
$I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	$V_{BE}$	max.	820	mV

I <sub>C</sub> = 10 mA; I <sub>B</sub> = 0,5 i	nΑ

Saturation voltage<sup>▲</sup>

	V <sub>BEsat</sub>	typ. 700 mV
$I_C = 100 \text{ mA}; I_B = 5 \text{ mA}$	VCEsat	typ. 250 mV max. 650 mV
	V <sub>BEsat</sub>	typ. 900 mV
follector canacitance at f = 1 MHz		

Collector capacitance at f = 1 MHz

IE = ie	$= 0; V_{CE} = 10 V$	

 $C_{c}$ 

**VCEsat** 

typ.

typ.

max.

3 pF

90 mV

300 mV

<sup>\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

<sup>\*\*</sup>  $V_{BEsat}$  decreases by approx. 1,7 mV/K with increasing temperature.

<sup>-</sup>VBE decreases by about 2 mV/K with increasing temperature.

Transition frequency at f = 35 MHz				
$I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$		fΤ	min.	100 MHz
Noise figure at f = 35 MHz				
$I_C = 200 \mu\text{A}; V_{CE} = 5 \text{V};$			typ.	2 dB
f = 1 kHz; B = 200 Hz		F	max.	10 dB
Small signal current gain at f = 1 kHz				
$I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}$		h <sub>fe</sub>	75	to 900
D.C. current gain			min.	75
$I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	BCV65	hFE	max.	800
			min.	200
	BCV65B	hFE	typ.	290
			max	475

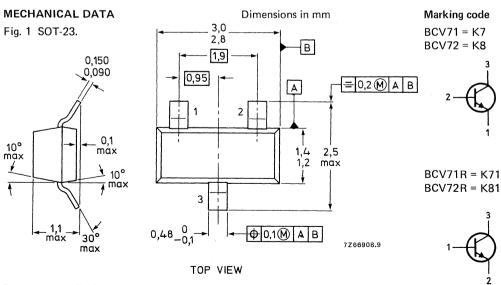
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ACTANIA DO GARAGA

N-P-N transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

#### QUICK REFERENCE DATA

			BCV71	BCV72	
D.C. current gain at $T_j = 25$ °C $I_C = 2$ mA; $V_{CE} = 5$ V	hFE	> <	110 220	200 450	-
Collector-base voltage (open emitter)	$V_{CBO}$	max.	8	0	V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	6	0	V
Collector current (peak value)	I <sub>CM</sub>	max.	20	0	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	35	0	mW
Junction temperature	Τj	max.	17	5	оС
Transition frequency at $f = 35 \text{ MHz}$ I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 5 V	f <sub>T</sub>	typ.	30	0	MHz
Noise figure at R <sub>S</sub> = $2 \text{ k}\Omega$ I <sub>C</sub> = $200 \mu\text{A}$ ; V <sub>CE</sub> = $5 \text{ V}$ ; f = $1 \text{ kHz}$ ; B = $200 \text{ Hz}$	F	<	1	0	dB



R-types are available on request See also *Soldering recommendations*.

HATINGS				
Limiting values in accordance with the Absolute Max	imum System (IEC 134)			
Collector-base voltage (open emitter) see Fig. 2	V <sub>CBO</sub>	max.	80	V
Collector-emitter voltage (open base) see Fig. 2				
$I_C = 2 \text{ mA}$	VCEO	max.	60	V
Emitter-base voltage (open collector) see Fig. 2	V <sub>EBO</sub>	max.	5	V
Collector current (d.c.)	IC	max. 1	00	mΑ
Collector current (peak value)	ICM	max. 2	200	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C**	P <sub>tot</sub>	max. 3	350	mW
Storage temperature	T <sub>stg</sub>	-65 to + 1	175	оС
Junction temperature	$T_{j}$	max. 1	175	оС
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	= -	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	= 2	280	K/W
From soldering points to ambient**	$R_{ths-a}$	=	90	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$	СВО	< 1	100	nA
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$ ; $T_j = 100 ^{\circ}\text{C}$	ICBO	<	10	μΑ
Base emitter voltage				
$I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	V <sub>BE</sub>	550 to 7	700	mV
Saturation voltages		typ. 1	120	mV
$I_C = 10 \text{ mA}; I_B = 0.5 \text{ mA}$	V <sub>CEsat</sub>			mV
	V <sub>BEsat</sub>	typ. 7	750	mV.
$I_C = 50 \text{ mA}; I_B = 2,5 \text{ mA}$	<b>V</b> CEsat			mV
	V <sub>BEsat</sub>	typ. 8	350	mV

See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain			BCV71	BCV72		
$I_C = 10 \mu\text{A}; V_{CE} = 5 V$	hFE	typ.	90	150		
$I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	hFE	> <	110 220	200 450		
Collector capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0$ ; $V_{CB} = 10 \text{ V}$	C <sub>c</sub>	typ.	2	,5	pF	<b></b>
Transition frequency at f = 35 MHz $I_C = 10$ mA; $V_{CE} = 5$ V	fΤ	typ.	30	00	MHz	
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CE</sub> = 5 V f = 1 kHz; B = 200 Hz	F	<	. 1	0	dB	

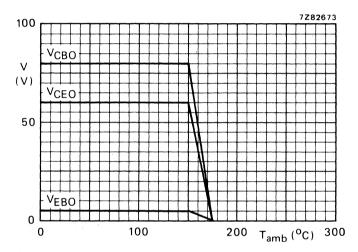


Fig. 2 Voltage derating curves.

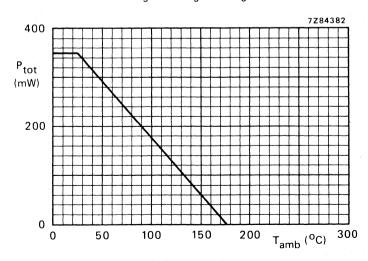


Fig. 3 Power derating curve.

u telepasi kalintaka Kihimpasi kalinta

P-N-P transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

#### QUICK REFERENCE DATA

			BCW29	BCW30	
D.C. current gain at $T_j = 25$ °C $-1_C = 2$ mA; $-V_{CE} = 5$ V	h <sub>FE</sub>	> <	120 260	215 500	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	3	2	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	3	2	V
Collector current (peak value)	-ICM	max.	20	0	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	35	0	mW
Junction temperature	$T_{i}$	max.	17	5	oC
Transition frequency at f = 35 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f <sub>T</sub>	typ.	15	0	MHz
Noise figure at R <sub>S</sub> = $2 \text{ k}\Omega$ $-\text{I}_{\text{C}}$ = $200 \mu\text{A}$ ; $-\text{V}_{\text{CE}}$ = $5 \text{ V}$ ; f = $1 \text{ kHz}$ ; B = $200 \text{ Hz}$	F	<	1	0	dB

#### **MECHANICAL DATA** Dimensions in mm Marking code 3,0 2,8 BCW29 = C1 Fig. 1 SOT-23. В BCW30 = C2 1,9 0,150 0,090 0,95 = 0,2 (M) A B Α 2 0,1 max 10° max 1,4 2,5 1,2 max ₹ 10° BCW29R = C4₩ max BCW30R = C53 \_ 1,1 . max Ф0,1(M) A В 30° 7Z66908.9 max

TOP VIEW

R-types are available on request

See also Soldering recommendations.

RATINGS			
Limiting values in accordance with the Absolute Maxi	mum System (IEC	134)	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	32 V
Collector-emitter voltage (V <sub>BE</sub> = 0)	-V <sub>CES</sub>	max.	32 V
Collector-emitter voltage (open base) $-I_C = 2 \text{ mA}$	−V <sub>CEO</sub>	max.	
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	5 V
Collector current (d.c.)	−lC	max.	100 mA
Collector current (peak value)	-I <sub>CM</sub>	max.	200 mA
Total power dissipation up to $T_{amb} = 25  {}^{\circ}C^{**}$	P <sub>tot</sub>	max.	350 mW
Storage temperature	$T_{stg}$		-65 to +175 °C
Junction temperature	T <sub>j</sub>	max.	175 °C
THERMAL CHARACTERISTICS*			
$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$			
Thermal resistance			
From junction to tab	R <sub>th j-t</sub>		50 K/W
From tab to soldering points	R <sub>th t-s</sub>		280 K/W
From soldering points to ambient**	R <sub>th s-a</sub>		90 K/W
CHARACTERISTICS			
T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified			
Collector cut-off current			
I <sub>E</sub> = 0; -V <sub>CB</sub> = 32 V	<sup>−</sup> Iсво	< "	100 nA
$I_E = 0$ ; $-V_{CB} = 32 \text{ V}$ ; $T_j = 100 ^{\circ}\text{C}$ Base-emitter voltage	- ICBO		10 μΑ
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	-V <sub>BE</sub>		600 to 750 mV
Saturation voltages			
$-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ mA}$	-V <sub>CEsat</sub>	typ.	80 mV 300 mV
	$-V_{BEsat}$	typ.	720 mV
$-I_C = 50 \text{ mA}; -I_B = 2.5 \text{ mA}$	$-V_{CEsat} \\ -V_{BEsat}$	typ. typ.	150 mV 810 mV

See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.

D.C. current gain		BCW29	BCW3	0	
$-I_C = 10 \mu\text{A}; -V_{CE} = 5 \text{V}$	hFE	typ. 90	150	0	
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	hFE	> 120 < 260	21! 500	_	
Collector-capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0$ ; $-V_{CB} = 10 \text{ V}$	C <sub>c</sub>	typ.	4,5	p <b>F</b>	· —
Transition frequency at f = 35 MHz $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	fT	typ.	150	MHz	
Noise figure at R <sub>S</sub> = 2 k $\Omega$ $-I_C$ = 200 $\mu$ A; $-V_{CE}$ = 5 V f = 1 kHz; B = 200 Hz	F	<	10	dB	

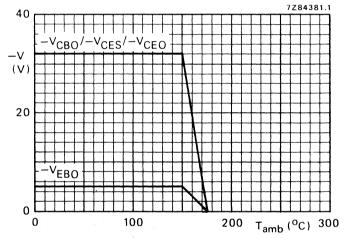


Fig. 2 Voltage derating curves.

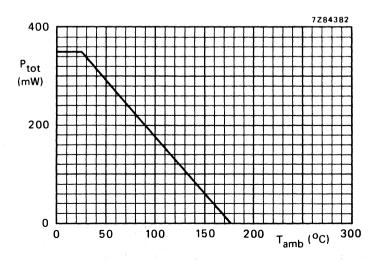


Fig. 3 Power derating curve.

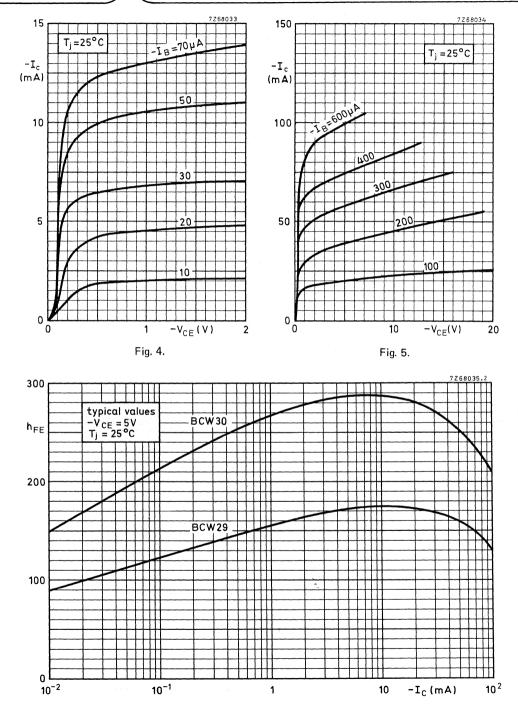
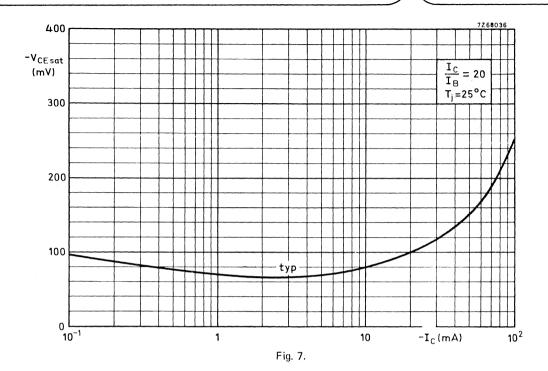
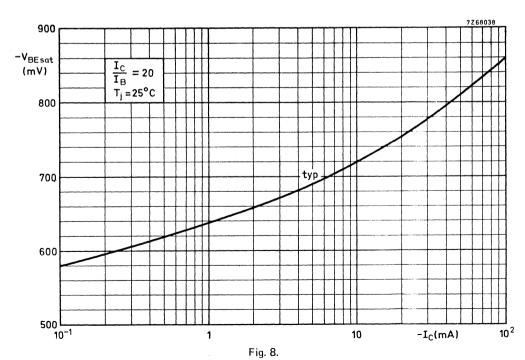
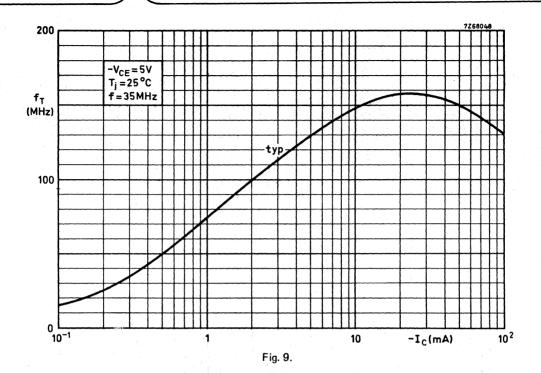


Fig. 6.







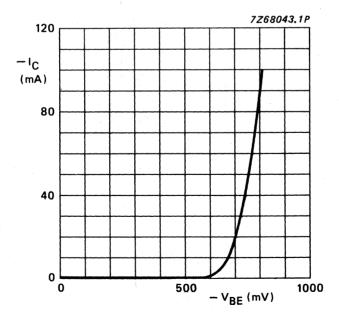
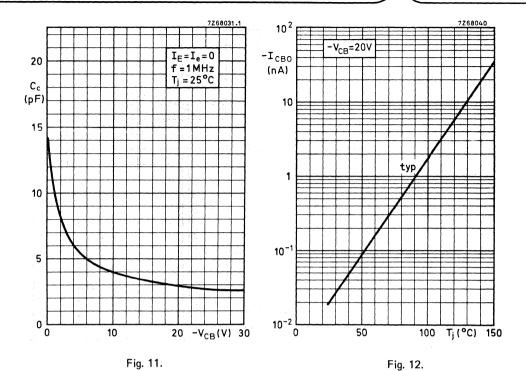


Fig. 10  $V_{CE} = 5 \text{ V; } T_j = 25 \text{ }^{\circ}\text{C; typical values.}$ 



N-P-N transistors in a microminiature plastic envelope. They are intended for low level general purpose applications in thick and thin-film circuits.

#### QUICK REFERENCE DATA

See also Soldering recommendations.

			BCW31	BCW32	BCW33	
D.C. current gain at $T_j = 25$ °C $I_C = 2$ mA; $V_{CE} = 5$ V	hFE	> <	110 220	200 450	420 800	_
Collector-base voltage (open emitter)	$v_{CBO}$	max.		32		V
Collector-emitter voltage (open base)	VCEO	max.		32		V
Collector current (peak value)	ICM	max.		200		mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.		350		mW
Junction temperature	Τj	max.		175		οС
Transition frequency at $f = 35 \text{ MHz}$ $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	fŢ	ţyp.		300		MHz
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CE</sub> = 5 V;						
f = 1 kHz; B = 200 Hz	F	<		10		dB

#### **MECHANICAL DATA** Dimensions in mm Marking code 3,0 Fig. 1 SOT-23. BCW31 = D1 2.8 BCW32 = D2 В 1,9 BCW33 = D3 0,150 0,090 0,95 0,2 M A B Α 0.1 10° max max 2,5 max ₹ 10° BCW31R = D4 √ max BCW32R = D53 BCW33R = D6**⊕** 0,1 M 30° 7Z66908.9A max TOP VIEW R-types are available on request.

June 1987

Limiting values in	n accordance with	the Absolute	Maximum S	vstem (IEC134)

Collector-base voltage (open emitter)	$v_{\sf CBO}$	max.	32 V
Collector-emitter voltage (open base) IC = 2 mA	V <sub>CEO</sub>	max.	32 V
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.	5 V
Collector current (d.c.)	IC	max.	100 mA
Collector current (peak value)	ICM	max.	200 mA
Total power dissipation up to $T_{amb} = 25  {}^{\circ}C^{**}$	$P_{tot}$	max.	350 mW
Storage temperature	$T_{stg}$	6!	5 to +175 °C
Junction temperature	Τ <sub>i</sub>	max.	175 °C

#### THERMAL CHARACTERISTICS\*

$$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$

### Thermal resistance

From junction to tab	R <sub>th j-t</sub>	=	50 K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280 K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90 K/W

### CHARACTERISTICS

 $T_j = 25$  °C unless otherwise specified

Collector cut-off current

$I_E = 0$ ; $V_{CB} = 32 V$	ICBO	<	100 nA
I <sub>E</sub> = 0; V <sub>CB</sub> = 32 V; T <sub>i</sub> = 100 °C	<sup>I</sup> CBO	<	10 μΑ
Base-emitter voltage			
$I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}$	$v_{BE}$		550 to 700 mV

Saturation voltages

•		V <sub>CEsat</sub>	typ.	120 mV
. 10 4 . 05 4		V CEsat	<	250 mV
IC 10 mA; IB = 0,5 mA		$V_{BEsat}$	typ.	750 mV
1 - = = = = = = = = = = = = = = = = = =	Λ	VCEsat	typ.	210 mV
$I_C = 50 \text{ mA}$ ; $I_B = 2.5 \text{ m}$		VREsat	tvp.	850 mV

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain		BCW31	BCW32	BCW33	annada .
$I_{C}$ = 10 $\mu$ A, $V_{CE}$ = 5 $V$	hFE typ	. 90	150	270	
$I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}$	h <sub>FE</sub> >	110 220	200 450	420 800	
Collector capacitance at f = 1 MHz  IE = Ie = 0; VCB = 10 V  Transition fragments at f = 3E MHz	C <sub>C</sub>	typ.	1	) 2,5 p	F
Transition frequency at $f = 35 \text{ MHz}$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	$f_T$	typ.	3	00 N	ЛНz
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CE</sub> = 5 V f = 1 kHz; B = 200 Hz	F	<		10 d	В

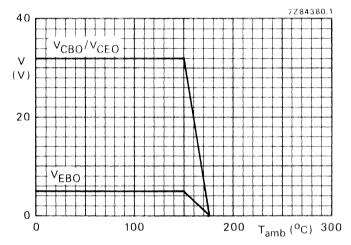


Fig. 2 Voltage derating curves.

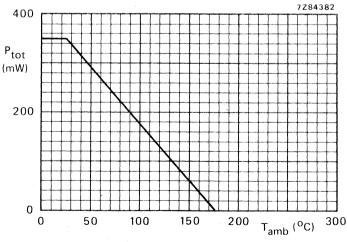


Fig. 3 Power derating curve.

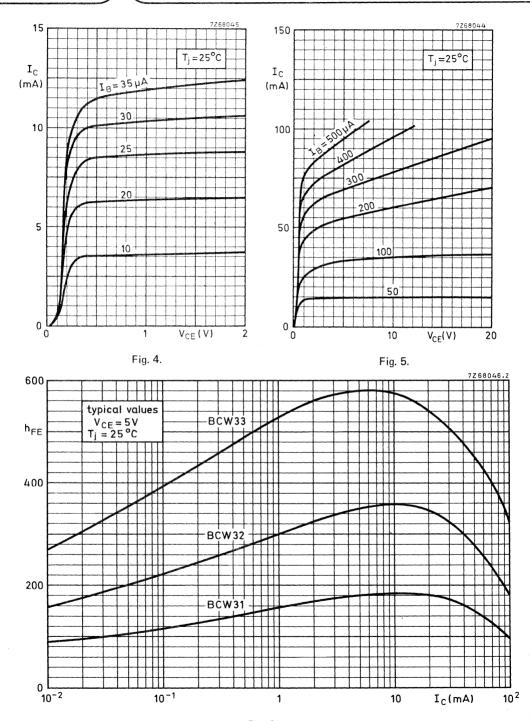
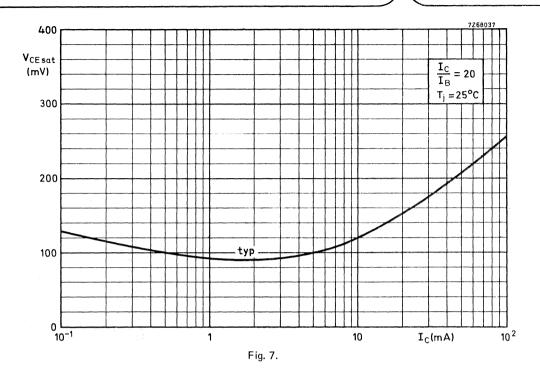
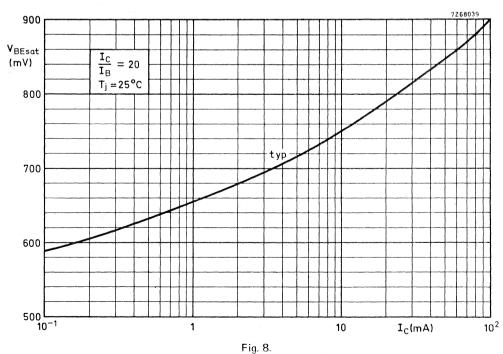
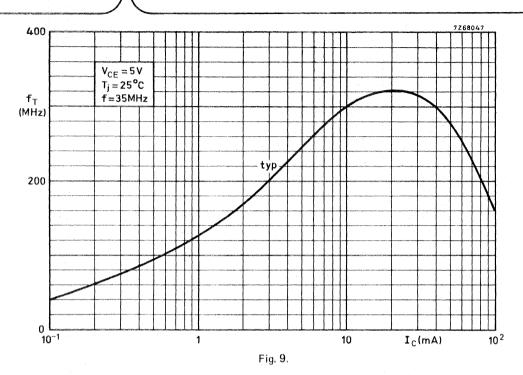


Fig. 6.







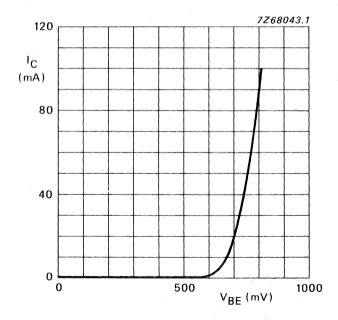
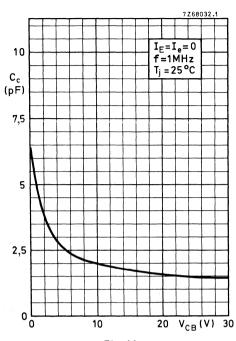


Fig. 10  $V_{CE}$  = 5 V;  $T_j$  = 25 °C; typical values.



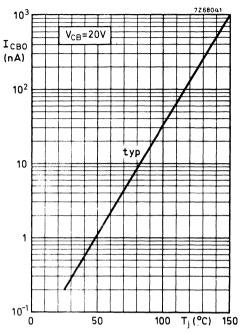


Fig. 12.

N-P-N silicon transistors, in a microminiature plastic envelope, intended for low level, low noise, low frequency purpose applications in hybrid circuits.

#### **QUICK REFERENCE DATA**

Collector-emitter voltage ( $V_{BE} = 0$ )	V <sub>CES</sub>	max.	32 V
Collector-emitter voltage (open base)	$v_{\sf CEO}$	max.	32 V
Collector current (d.c.)	I <sub>C</sub>	max.	200 mA
Total power dissipation	$P_{tot}$	max.	150 mW
Junction temperature	Τį	max.	150 °C
Transition frequency at f = 100 MHz V <sub>CE</sub> = 5 V; I <sub>C</sub> = 10 mA	f <sub>T</sub>	typ.	250 MHz
Noise figure at f = 1 kHz $V_{CE} = 5 \text{ V}; I_{C} = 200 \mu\text{A}; B = 200 \text{ Hz}$	F	typ.	2 dB

#### **MECHANICAL DATA** Dimensions in mm Marking code Fig. 1 SOT-23. BCW60A = AABCW60B = AB3,0 2,8 BCW60C = ACВ BCW60D = AD1,9 0,150 0,090 0,95 0,2 M A B Α 2 0,1 max 10° max 2,5 1,4 max <u>₹</u> 10° ∓ max 3 \_1,1 \_max **⊕**|0,1(M) 30° 7Z66908.9 max

TOP VIEW

See also Soldering recommendations.

# **BCW60 SERIES**

#### RATINGS

	RATINGS				
	Limiting values in accordance with the Absolute Maximum System (	EC 134)			
	Collector-emitter voltage (V <sub>BE</sub> = 0)	V <sub>CES</sub>	max.	32	٧
	Collector-emitter voltage (open base)	$V_{CEO}$	max.	32	V
	Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.	5	V
	Collector current (d.c.)	I <sub>C</sub>	max.	200	mA
	Base current	I <sub>B</sub>	max.	50	mA
	Total power dissipation up to T <sub>amb</sub> = 100 °C**	P <sub>tot</sub>	max.	150	mW
	Storage temperature	T <sub>stg</sub>	-55 to +	125	oC :
	Junction temperature	Ti	max.	150	οС
	TUEDMAL QUADACTEDICTION	• •••	erantus f		
		Hit organi			
	$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
	Thermal resistance	事者中 日東大阪日本 -			
	From junction to tab	R <sub>th j-t Sr:</sub>		50	K/W
	From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
	From soldering points to ambient**	R <sub>th s-a</sub>	= 1 11 11	90	K/W
	CHADACTEDISTICS				
	CHARACTERISTICS  The second se				
	T <sub>amb</sub> = 25 °C unless otherwise specified Collector-emitter cut-off current				
	$V_{BE} = 0$ ; $V_{CE} = 32 \text{ V}$	ICES	<	20	nA
	V <sub>BE</sub> = 0; V <sub>CE</sub> = 32 V; T <sub>amb</sub> = 150 °C	CES	<	20	μΑ
	Emitter-base cut-off current	CLO			•
	I <sub>C</sub> = 0; V <sub>EB</sub> = 4 V	<sup>I</sup> EBO	<	20	nΑ
	Saturation voltages				
	at $I_C = 10 \text{ mA}$ ; $I_B = 0.25 \text{ mA}$	V <sub>CEsat</sub>	0,05 to	•	
		$V_{BEsat}$	0,6 to		
	at $I_C = 50 \text{ mA}$ ; $I_B = 1,25 \text{ mA}$	V <sub>CEsat</sub>	0,1 to		
		<b>V</b> BEsat	0,7 to	1,05	V
	Transition frequency at f = 100 MHz ▲ I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 5 V	f	>	125	MHz
		fT	typ.	250	MHz
	Collector capacitance at f = 1 MHz	C	41.00	2 =	n.E
-	I <sub>E</sub> = I <sub>e</sub> = 0; V <sub>CB</sub> = 10 V Emitter capacitance at f = 1 MHz	C <sub>C</sub>	typ.	2,5	þΓ
	$I_C = I_C = 0$ ; $V_{EB} = 0.5 \text{ V}$	C <sub>e</sub>	typ.	8	рF
	N. C. C. D. O. O.	G	. , 1-	_	• • •

2 dB

6 dB

typ.

Noise figure at R  $_{S}$  = 2 k  $\Omega$   $_{I_{C}}$  = 200  $\mu$ A; V  $_{CE}$  = 5 V; f = 1 kHz; B = 200 Hz

See Thermal characteristics.

Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Measured under pulse conditions.

			_A	В	С	D	
D.C. current gain $V_{CE} = 5 \text{ V}; I_{C} = 10 \mu\text{A}$	hFE	t <b>y</b> p.	78 	145 20	220 40	300 100	
$V_{CE} = 5 \text{ V}; I_{C} = 2 \text{ mA}$	hFE	> typ. <	120 170 220	180 250 310	250 350 460	380 500 630	
$V_{CE} = 1 \text{ V; } I_{C} = 50 \text{ mA}$	hFE	>	50	70	90	100	
Input impedance $V_{CE} = 5 \text{ V; } I_{C} = 2 \text{ mA; } f = 1 \text{ kHz}$	h <sub>ie</sub>	t <b>y</b> p.	2,7	3,6	4,5	7,5 kΩ	<b>→</b>
Reverse voltage transfer ratio $V_{CE} = 5 \text{ V}$ ; $I_{C} = 2 \text{ mA}$ ; $f = 1 \text{ kHz}$	h <sub>re</sub>	t <b>y</b> p.	1,5	2	2	3 10 <sup>-4</sup>	
Small-signal current gain $V_{CE} = 5 \text{ V}$ ; $I_{C} = 2 \text{ mA}$ ; $f = 1 \text{ kHz}$	h <sub>fe</sub>	t <b>y</b> p.	200	260	330	520	•
Output admittance VCE = 5 V; IC = 2 mA; f = 1 kHz	h <sub>oe</sub>	t <b>y</b> p.	18	24	30	50 μs	<b>←</b>
Base-emitter voltage V <sub>CE</sub> = 5 V; I <sub>C</sub> = 2 mA	V <sub>BE</sub>	t <b>y</b> p.	0,	55 to 0, 0,	75 65	V V	
$V_{CE} = 5 \text{ V; } I_{C} = 10 \mu A$	$V_{BE}$	t <b>y</b> p.		0,	52	V	
$V_{CE} = 1 \text{ V; } I_{C} = 50 \text{ mA}$	$V_{BE}$	typ.		0,	78	V	

# **BCW60 SERIES**

### Switching times

 $I_{Con}$  = 10 mA;  $I_{Bon}$  =  $-I_{Boff}$  = 1 mA  $V_{CC}$  = 10 V;  $R_L$  = 990  $\Omega$ typ. 85 ns turn-on time  $(t_d + t_r)$ ton < 150 ns typ. 480 ns turn-off time  $(t_S + t_f)$ 

toff

800 ns

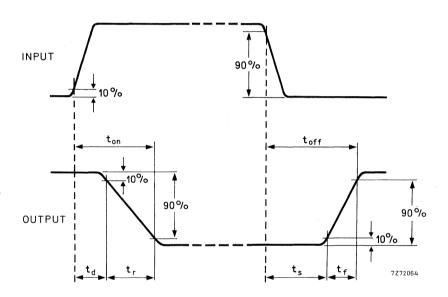
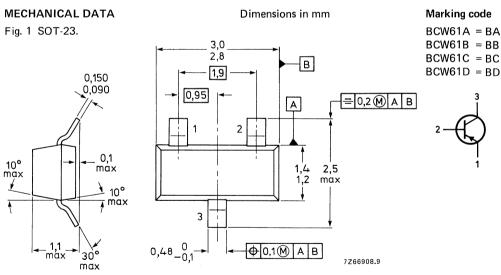


Fig. 2 Switching waveforms.

P-N-P silicon transistors, in a microminiature plastic envelope, intended for low level, low noise, low frequency purpose applications in hybrid circuits.

### QUICK REFERENCE DATA

Transition frequency at $f = 100 \text{ MHz}$ $-V_{CE} = 5 \text{ V}; -I_{C} = 10 \text{ mA}$	f <sub>T</sub>	typ.	180 MHz
Total power dissipation  Junction temperature  Transition fraggraphy at f = 100 MHz	P <sub>tot</sub> T <sub>j</sub>	max. max.	150 MW
Collector current (d.c.)	−lC	max.	200 mA 150 mW
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	32 V
Collector-emitter voltage ( $V_{BE} = 0$ )	$-v_CES$	max.	32 V



TOP VIEW

# **BCW61 SERIES**

### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-emitter voltage (V<sub>BE</sub> = 0) -V<sub>CES</sub> max. 32 V

Collector-emitter voltage (open base) -V<sub>CEO</sub> max. 32 V

Emitter-base voltage (open collector)  $-V_{EBO}$  max. 5 V Collector current (d.c.)  $-I_{C}$  max. 200 mA

Base current  $-I_B$  max. 50 mA Total power dissipation up to  $T_{amb} = 100 \, ^{\circ}\text{C}^{**}$   $P_{tot}$  max. 150 mW

Storage temperature  $T_{stg}$  -55 to +125 °C Junction temperature  $T_{i}$  max. 150 °C

### THERMAL CHARACTERISTICS\*

 $T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

### Thermal resistance

From junction to tab  $R_{th j-t} = 50 \text{ K/W}$ From tab to soldering points  $R_{th t-s} = 280 \text{ K/W}$ 

From tab to soldering points  $R_{th t-s} = 280 \text{ K/W}$ From soldering points to ambient\*\*  $R_{th s-a} = 90 \text{ K/W}$ 

### CHARACTERISTICS

T<sub>amb</sub> = 25 °C unless otherwise specified

 $-I_C = 10 \text{ mA}; -I_B = 0.25 \text{ mA}$ 

Collector-emitter cut-off current

 $V_{EB} = 0; -V_{CE} = 32 \text{ V}$   $-I_{CES} < 20 \text{ nA}$   $V_{EB} = 0; -V_{CE} = 32 \text{ V}; T_{amb} = 150 \text{ °C}$   $-I_{CES} < 20 \mu A$ 

Emitter-base cut-off current  $I_C = 0$ ;  $-V_{EB} = 4 V$   $-I_{EBO}$  < 20 nA

IC = 0; -VEB = 4 V -IEBO < 20 n/s
Saturation voltages

-V<sub>BEsat</sub> 0,6 to 0,85 V

 $-I_C = 50 \text{ mA}; -I_B = 1,25 \text{ mA}$   $-V_{CEsat}$  0,12 to 0,55 V  $-V_{REsat}$  0,68 to 1,05 V

0,06 to 0,25 V

-V<sub>CEsat</sub>

-V<sub>BEsat</sub> 0,68 to 1,05 V Transition frequency at f = 100 MHz ▲

 $-V_{CE} = 5 \text{ V}; -I_{C} = 10 \text{ mA}$  f<sub>T</sub> typ. 180 MHz Collector capacitance at f = 1 MHz

 $-V_{EB} = 0.5 \text{ V}; I_C = I_c = 0$  Ce typ. 11 pF

Noise figure at R<sub>S</sub> = 2 k $\Omega$  $-V_{CE}$  = 5 V;  $-I_{C}$  = 200  $\mu$ A; B = 200 Hz F < 4 dB < 6 dB

- \* See Thermal characteristics.
- \*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.
- Measured under pulse conditions.

			Α	В	С	D	
D.C. current gain $-V_{CE} = 5 \text{ V}$ ; $-I_{C} = 10 \mu\text{A}$	h <sub>FE</sub>	typ.	140	200 30	270 40	340 100	
$-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}$	h <sub>FE</sub>	> typ. <	120 170 220	180 250 310	250 350 460	380 500 630	
$-V_{CE} = 1 V; -I_{C} = 50 \text{ mA}$	hFE	>	60	80	100	110	
Input impedance $-V_{CE} = 5 V; -I_{C} = 2 mA; f = 1 kHz$	h <sub>ie</sub>	typ.	2,7	3,6	4,5	7,5 kΩ	•
Reverse voltage transfer ratio $-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>re</sub>	typ.	1,5	2	2	3 10 <sup>-4</sup>	
Small-signal current gain $-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>fe</sub>	typ.	200	260	330	520	<b>←</b>
Output admittance $-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>oe</sub>	typ.	18	24	30	50 μS	•
Base-emitter voltage $-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}$	V <sub>BE</sub>	typ.	0,	6 to 0,7 0,6		V	
$-V_{CE} = 5 V; -I_{C} = 10 \mu A$	$V_{BE}$	typ.		0,5	5	V	6
$-V_{CE} = 1 V; -I_{C} = 50 \text{ mA}$	$V_{BE}$	typ.		0,7	2	V	

# **BCW61 SERIES**

# Switching times

$$-I_{Con}$$
 = 10 mA;  $-I_{Bon}$  =  $I_{Boff}$  = 1 mA  
- $V_{CC}$  = 10 V;  $R_L$  = 990  $\Omega$ 

turn-on time  $(t_d + t_r)$ 

turn-off time (t<sub>s</sub> + t<sub>f</sub>)

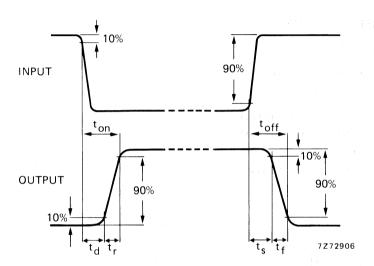


Fig. 2 Switching waveforms.

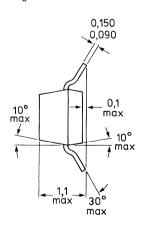
P-N-P transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

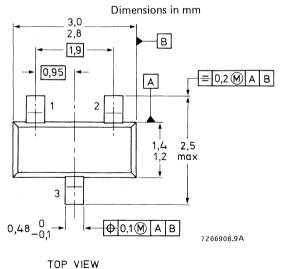
### **OUICK REFERENCE DATA**

				1	
			BCW69	BCW70	
D.C. current gain at $T_j = 25 ^{\circ}\text{C}$ $-\text{I}_{\text{C}} = 2 \text{mA}; -\text{V}_{\text{CE}} = 5 \text{V}$	hFE	> <	120 260	215 500	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	5	0	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	4	5	V
Collector current (peak value)	-ICM	max.	20	0	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	35	0	mW
Junction temperature	Тj	max.	17	5	oC
Transition frequency at f = 35 MHz $-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	$f_T$	typ.	15	0	MHz
Noise figure at $R_S = 2 k\Omega$					
-I <sub>C</sub> = 200 μA; -V <sub>CE</sub> = 5 V; f = 1 kHz; B = 200 Hz	F	<	1	0	dB

### **MECHANICAL DATA**

Fig. 1 SOT-23.





Marking code BCW69 = H1 BCW70 = H2



BCW69R = H4 BCW70R = H5



R-types are available on request.

Limiting values in accordance with the Absolute Maximum System (IEC134)

Collector-base voltage (open emitter) see Fig. 2	-V <sub>CBO</sub>	max. 5	0 V
Collector-emitter voltage (V <sub>BE</sub> = 0) see Fig. 2	-V <sub>CES</sub>	max. 5	0 V
Collector-emitter voltage (open base) see Fig. 2			
$-I_C = 2 \text{ mA}$	-V <sub>CEO</sub>	max. 4	5 V
Emitter-base voltage (open collector) see Fig. 2	-V <sub>EBO</sub>	max.	5 V
Collector current (d.c.)	-IC	max. 10	0 mA
Collector current (peak value)	-I <sub>CM</sub>	max. 20	0 mA
Total power dissipation up to $T_{amb} = 25  {}^{\circ}C^{**}$	P <sub>tot</sub>	max. 35	0 mW
Storage temperature	T <sub>stg</sub>	-65 to + 17	5 °C

 $\mathsf{T}_{\mathsf{i}}$ 

175 °C

100 nA

### THERMAL CHARACTERISTICS\*

$$T_i = Px (R_{th i-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$

## Thermal resistance

Junction temperature

From junction to tab	R <sub>th j-t</sub> =	50 K/W
From tab to soldering points	$R_{th t-s} =$	280 K/W
From soldering points to ambient**	$R_{th s-a} =$	90 K/W
CHARACTERISTICS		

T <sub>j</sub> = 25 °C unless otherwise specified			
Collector cut-off current			
$I_E = 0; -V_{CB} = 20 \text{ V}$	$-I_{CBO}$	<	

2 05	CDC		/
$I_E = 0; -V_{CB} = 20 V; T_j = 100 °C$	-I <sub>CBO</sub>	<	10 μA
Base-emitter voltage			
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	-V <sub>BE</sub>		600 to 750 mV
Saturation voltages	-VcEcat	typ.	80 mV

attraction voltages 
$$-V_{CEsat}$$
 typ. 80 mV 
$$-I_{C} = 10 \text{ mA}; -I_{B} = 0,5 \text{ mA}$$
 
$$-V_{BEsat}$$
 typ. 720 mV 
$$-I_{C} = 50 \text{ mA}; -I_{B} = 2,5 \text{ mA}$$
 
$$-V_{CEsat}$$
 typ. 150 mV 
$$-V_{CEsat}$$
 typ. 810 mV

294

See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain			BCW69	BCW7	0	
$-I_C = 10 \mu\text{A}; -V_{CE} = 5 \text{V}$	hFE	typ.	90	150		
$-1_{C} = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	hFE	> <	120 260	215 500		
Collector capacitance at f = 1 MHz $I_E = I_e = 0$ ; $-V_{CB} = 10 V$	C <sub>c</sub>	typ.	Supramo anada tagangi	4,5	pF	-
Transition frequency at f = 35 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V	f <sub>T</sub>	typ.		150	MHz	
Noise figure at R <sub>S</sub> = $2 \text{ k}\Omega$ $-\text{I}_C = 200 \mu\text{A}; -\text{V}_{CE} = 5 \text{ V}$ f = $1 \text{ kHz}; B = 200 \text{ Hz}$	F	<		10	dB	

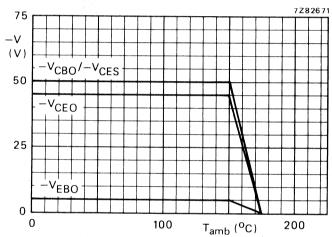


Fig. 2 Voltage derating curve.

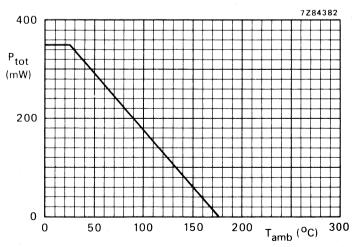
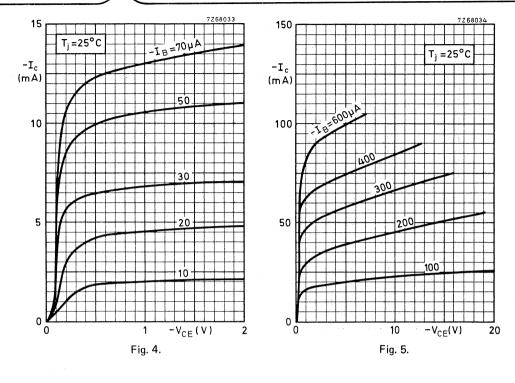


Fig. 3 Power derating curve.



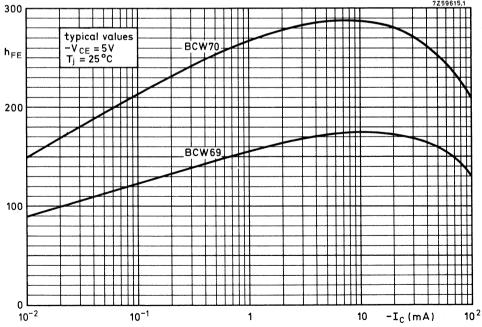


Fig. 6 D.C. current gain.

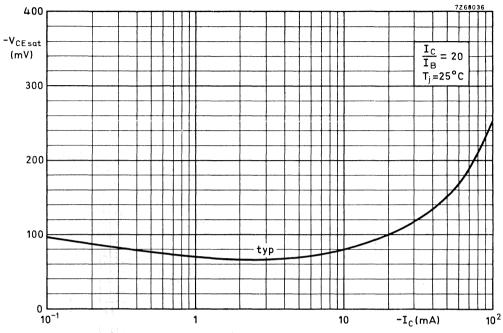


Fig. 7.

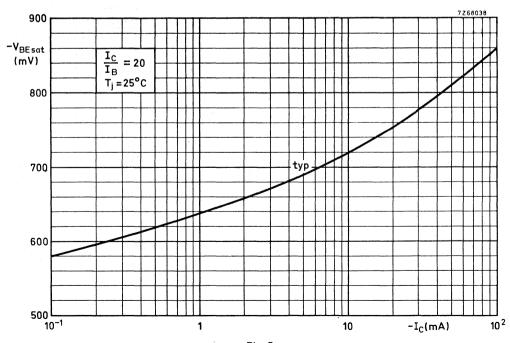


Fig. 8.

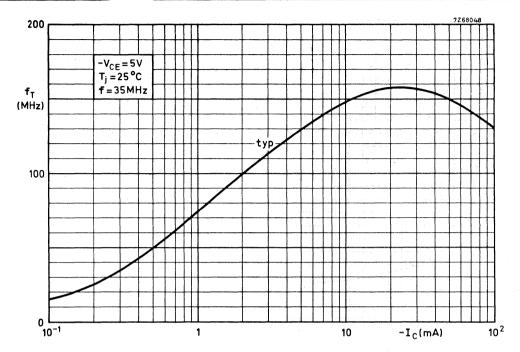


Fig. 9.

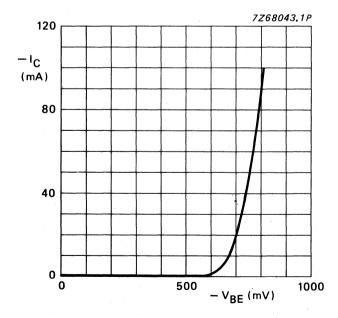


Fig. 10;  $-V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \,^{\circ}\text{C}$ ; typical values.

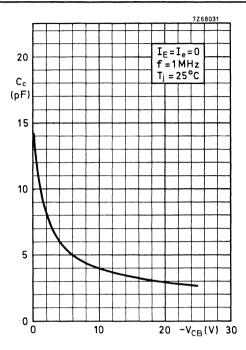


Fig. 11.

Fig. 12.

N-P-N transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

### QUICK REFERENCE DATA

			BCW71	BCW72	
D.C. current gain at $T_j = 25$ °C $I_C = 2$ mA; $V_{CE} = 5$ V	hFE	> <	110 220	200 450	
Collector-base voltage (open emitter)	$v_{CBO}$	max.	5	0	V
Collector-emitter voltage (open base)	VCEO	max.	4	5	V
Collector current (peak value)	I <sub>CM</sub>	max.	20	0	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	35	0	mW
Junction temperature	Τį	max.	17	5	oC
Transition frequency at f = 35 MHz $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	fT	typ.	30	0	MHz
Noise figure at R <sub>S</sub> = $2 k\Omega$ I <sub>C</sub> = $200 \mu$ A; V <sub>CE</sub> = $5 V$ ; f = $1 kHz$ ; B = $200 Hz$	F	<	1	0	dB

### Marking code **MECHANICAL DATA** Dimensions in mm 3,0 Fig. 1 SOT-23. BCW71 = K12,8 BCW72 = K2В 1,9 0,150 0,090 0,95 $= 0.2 \, \text{M} \, \text{A} \, \text{B}$ Α 2 0,1 10° max 1,4 2,5 max 1,2 máx ₹ 10° BCW71R = K4 → max BCW72R = K5 3 1,1 max **⊕** 0,1(M) A B 30° 7Z66908.9A max TOP VIEW R-types are available on request.

RATINGS				
Limiting values in accordance with the Absolute Maximum System	n (IEC 134)			
Collector-base voltage (open emitter) see Fig. 2	$V_{CBO}$	max.	50	٧
Collector-emitter voltage (open base) see Fig. 2			12.0	
$I_C = 2 \text{ mA}$	VCEO	max.	45	
Emitter-base voltage (open collector) see Fig. 2	VEBO	max.	5	
Collector current (d.c.)	lc	max.	100	
Collector current (peak value)	ICM	max.	200	mA
Total power dissipation up to $T_{amb} = 25  {}^{\circ}C^{**}$	P <sub>tot</sub>	max.	350	
Storage temperature	$T_{stg}$	65 to		
Junction temperature	Тj	max.	175	оС
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	( =	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	: = -	90	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Collector cut-off current I <sub>F</sub> = 0; V <sub>CB</sub> = 20 V	I <sub>CBO</sub>	<	100	nΑ
I <sub>E</sub> = 0; V <sub>CB</sub> = 20 V; T <sub>i</sub> = 100 °C	ICBO	<	10	μΑ
Base emitter voltage	CDO			
I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V	$V_{BE}$	550 t	o 700	mV
Saturation voltages		typ.	120	mV
$I_C = 10 \text{ mA}; I_B = 0.5 \text{ mA}$	VCE <sub>sat</sub>	<	250	mV
	V <sub>BEsat</sub>	typ.		mV
$I_C = 50 \text{ mA}; I_B = 2,5 \text{ mA}$	V <sub>CEsat</sub>	typ.		mV mV
	V <sub>BEsat</sub>	typ.	000	IIIV

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain				BCW71	BCW7	2
$I_C = 10 \mu\text{A}$ ; $V_{CE} = 5 \text{V}$		hFE	typ.	90	150	
$I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$		hFE	> <	110 220	200 450	
Collector capacitance at f = 1 I <sub>E</sub> = I <sub>e</sub> = 0; V <sub>CB</sub> = 10 V	MHz	C <sub>c</sub>	typ.		2,5	pF <b>←</b>
Transition frequency at $f = 35$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	5 MHz	fT	typ.	• ;	300	MHz
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CE</sub> = 5 V f = 1 kHz; B = 200 Hz		F	<		10	dB

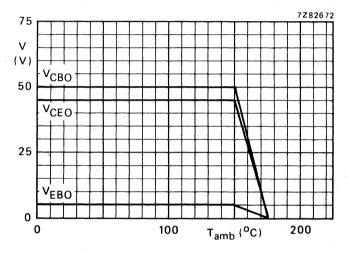


Fig. 2 Voltage derating curves.

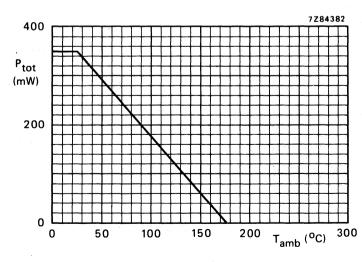
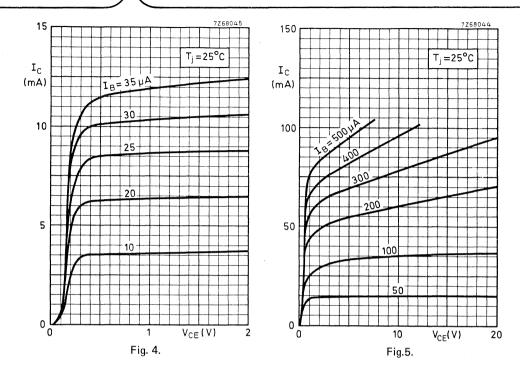


Fig. 3 Power derating curve.



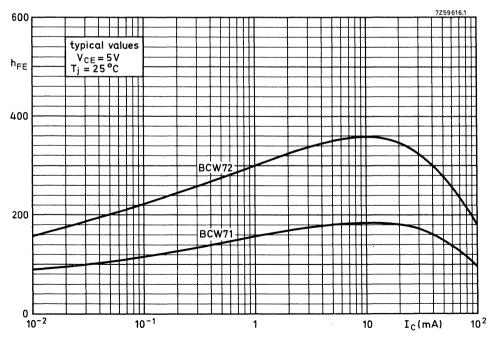


Fig. 6 D.C. current gain.

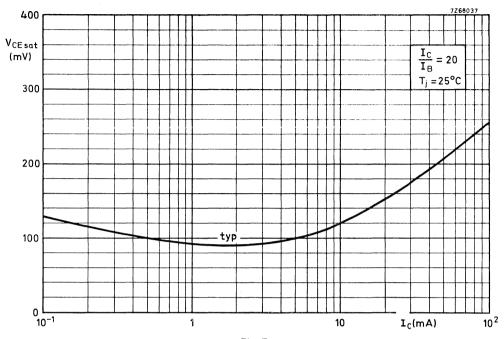


Fig. 7.

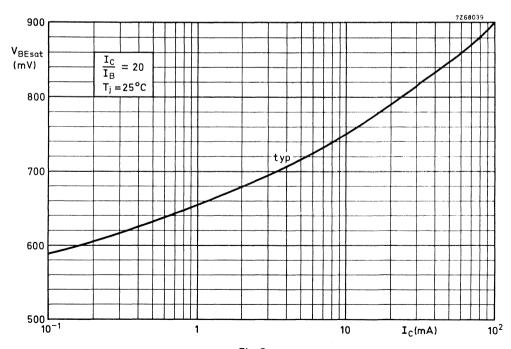
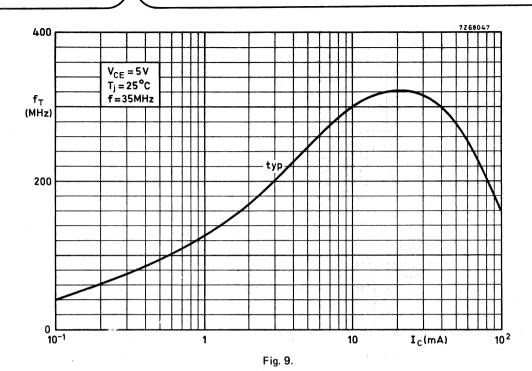


Fig. 8.



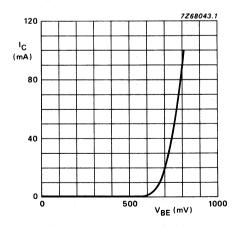
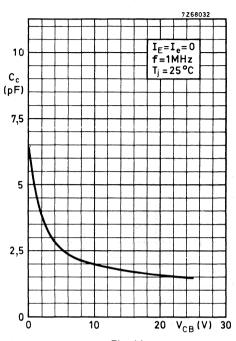


Fig. 10  $V_{CE}$  = 5 V;  $T_j$  = 25 °C; typical values.



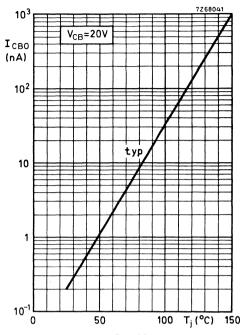


Fig. 12.

N-P-N transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

### **QUICK REFERENCE DATA**

Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	50 V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	45 V
Collector current (peak value)	<sup>I</sup> CM	max.	200 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	<b>350</b> mW
Junction temperature	Τį	max.	175 °C
D.C. current gain at $T_j = 25$ °C $I_C = 2$ mA; $V_{CE} = 5$ V	hFE	> <	420 800
Transition frequency at $f = 35 \text{ MHz}$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	300 MHz
Noise figure at $R_S = 2 k\Omega$ $I_C = 200 \mu A$ ; $V_{CE} = 5 V$ ; f = 1  kHz; $B = 200  Hz$	F	<	10 dB

### **MECHANICAL DATA** Dimensions in mm Marking code Fig. 1 SOT-23. BCW81 = K3 3,0 2,8 В 1,9 0,150 0.090 0,95 = 0,2 (M) A B Α 0,1 10° max 2,5 max max BCW81R = K31 10° ∓ max 3 \_ 1,1 \_ max Ф 0,1(M) 30° 7266908.9 max TOP VIEW

R-types are available on request

See also Soldering recommendations.

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Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance with the Absolute Maximum System	1 (IEC 134)			
Collector-base voltage (open emitter) see Fig. 2	V <sub>CBO</sub>	max.	50	V
Collector-emitter voltage (open base) see Fig. 2 $I_C = 2 \text{ mA}$	V <sub>CEO</sub>	max.	45	V
Emitter-base voltage (open collector) see Fig. 2	VEBO	max.	5	٧
Collector current (d.c.)	Ic	max.	100	mΑ
Collector current (peak value)	ICM	max.	200	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C**	$P_{tot}$	max.	350	mW
Storage temperature	T <sub>stg</sub>	-65 to +	175	οС

175 °C

max.

 $V_{\mathsf{BEsat}}$ 

typ.

850 mV

### **THERMAL CHARACTERISTICS\***

$$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$

### Thermal resistance

Junction temperature

From junction to tab	R <sub>th i-t</sub>	=	50 K/W
From tab to soldering points	R <sub>th t-s</sub>	= 1	280 K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90 K/W
CHARACTERISTICS			
T <sub>j</sub> = 25 °C unless otherwise specified			
Collector cut-off current I <sub>E</sub> = 0; V <sub>CB</sub> = 20 V	Ісво	<	100 nA
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$ ; $T_j = 100 \text{ °C}$	ICBO	<	10 μΑ
Base emitter voltage $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	V <sub>BE</sub>	550	to 700 mV
Saturation voltages $I_C = 10 \text{ mA}$ ; $I_B = 0.5 \text{ mA}$	V <sub>CEsat</sub>	typ.	120 mV 250 mV
I <sub>C</sub> = 50 mA; I <sub>B</sub> = 2,5 mA	V <sub>BEsat</sub> V <sub>CEsat</sub>	typ.	750 mV 210 mV

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm

D.C. current gain 
$$I_{C} = 2 \text{ mA}; \text{ V}_{CE} = 5 \text{ V} \\ \text{h}_{FE} \\ \text{e} \\ \text{o} \\ \text{o} \\ \text{l}_{C} = 2 \text{ mA}; \text{ V}_{CE} = 5 \text{ V} \\ \text{h}_{FE} \\ \text{e} \\ \text{o} \\$$

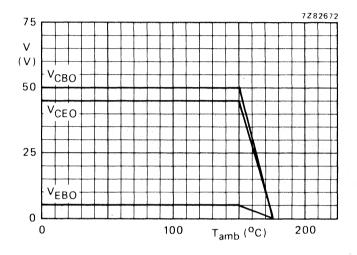


Fig. 2 Voltage derating curves.

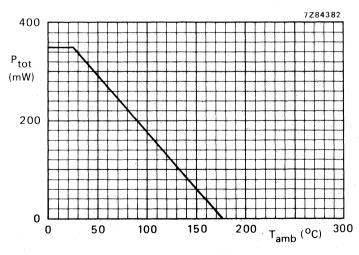
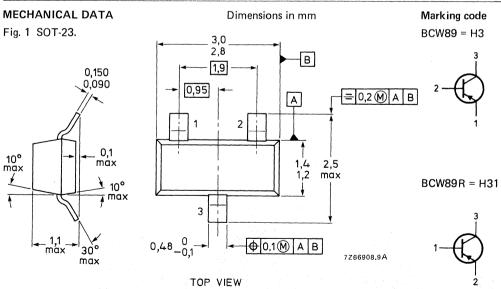


Fig. 3 Power derating curve.

P-N-P transistors, in a microminiature plastic envelope, intended for low level general purpose applications in thick and thin-film circuits.

### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	80 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	60 V
Collector current (peak value)	-I <sub>CM</sub>	max.	200 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350 mW
Junction temperature	$T_{j}$	max.	175 °C
D.C. current gain at $T_j = 25$ °C $-I_C = 2$ mA; $-V_{CE} = 5$ V	hFE	> <	120 260
Transition frequency at f = 35 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 5 V Noise figure at R <sub>S</sub> = 2 k $\Omega$	f <sub>T</sub>	typ.	150 MHz
$-I_C = 200 \mu A; -V_{CE} = 5 V;$ f = 1 kHz; B = 200 Hz	F	<	10 dB



R-types are available on request.

RATINGS				
Limiting values in accordance with the Absolute Maximum System	n (IEC 134)			
Collector-base voltage (open emitter) see Fig. 2	-V <sub>CBO</sub>	max.	80	V
Collector-emitter voltage (V <sub>BE</sub> = 0) see Fig. 2	-V <sub>CES</sub>	max.	60	V
Collector-emitter voltage (open base) see Fig. 2				
$-I_C = 2 \text{ mA}$	-VCEO	max.	60	٧
Emitter-base voltage (open collector) see Fig. 2	$-V_{EBO}$	max.	5	٧
Collector current (d.c.)	-1C	max.	100	mΑ
Collector current (peak value)	-ICM	max.	200	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C**	P <sub>tot</sub>	max.	350	mW
Storage temperature	T <sub>stg</sub>	-65 to +	175	oC
Junction temperature	$T_{j}$	max.	175	оС
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th i-t</sub>	=	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>ths-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0; -V_{CB} = 20 \text{ V}$	-ICBO	<	100	nΑ
$I_E = 0; -V_{CB} = 20 \text{ V}; T_j = 100 \text{ °C}$	-Ісво	<	10	μΑ
Base-emitter voltage $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; T_i = 25 \text{ °C}$	-V <sub>BE</sub>	600 to	750	mV
Saturation voltages		typ.	80	mV
$-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ mA}$	-V <sub>CEsat</sub>	< -	300	
	-V <sub>BEsat</sub>	typ.	720	mV
$-1_C = 50 \text{ mA}; -1_B = 2.5 \text{ mA}$	-V <sub>CEsat</sub>	typ.	150	
	-V <sub>BEsat</sub>	typ.	810	mV

See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain $-I_C = 10 \mu A$ ; $-V_{CE} = 5 V$	hFE	typ.	90	
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	hFE	> <	120 260	
Collector capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0; -V_{CB} = 10 \text{ V}$	$C_{c}$	typ.	4,5 pF <b>→</b>	
Transition frequency at $f = 35 \text{ MHz}$ $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	150 MHz	
Noise figure at R <sub>S</sub> = $2 k\Omega$ $-I_C = 200 \mu A$ ; $-V_{CE} = 5 V$ f = 1 kHz; $B = 200 Hz$	F	<	10 dB	

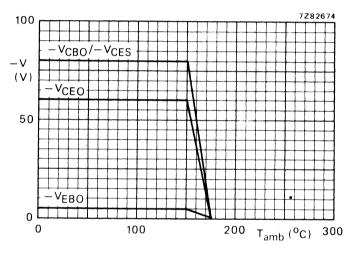


Fig. 2 Voltage derating curves.

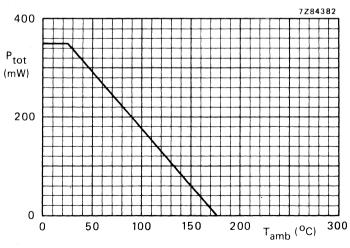


Fig. 3 Power derating curve.

P-N-P transistors, in a SOT-23 plastic envelope, intended for application in thick and thin-film circuits. These transistors are intended for general purposes as well as saturated switching and driver applications for industrial service.

N-P-N complements are BCX19 and BCX20 respectively.

### QUICK REFERENCE DATA

			BCX17	BCX18	
Collector-emitter voltage ( $V_{BE} = 0$ )	-V <sub>CES</sub>	max.	50	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	25	V
Collector current (peak value)	-I <sub>CM</sub>	max.	10	00	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	42	425	
Junction temperature	$T_{j}$	max.	1	75	oC
D.C. current gain $-I_C = 100 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE		100 to 60	00	
Transition frequency -IC = 10 mA; -VCE = 5 V; f = 35 MHz	f <sub>T</sub>	typ.	10	00	MHz

### MECHANICAL DATA Dimensions in mm Marking code Fig. 1 SOT-23. BCX17 = T1 3,0 2,8 BCX18 = T2В 1,9 0.150 0,090 0,95 0,2 (M) A Α 0,1 10° max max 2,5 1,2 máx 10° BCX17R = T4√ max BCX18R = T5 3 \_1,1 \_max $\Phi$ 0,1(M) '3Ò° 7Z66908.9A max TOP VIEW

R-types are available on request

Limiting values in accordance with the Absolute Maximum System (IEC 134)

	•	•	BCX17	BCX18	
Collector-emitter voltage (V <sub>BE</sub> = 0) (see Fig. 2)	-V <sub>CES</sub>	max.	50	30	_ V
Collector-emitter voltage (open base) $-I_C = 10 \text{ mA}$ (see Fig. 2)	-V <sub>CEO</sub>	max.	45	25	V
Emitter-base voltage (open collector) (see Fig. 2)	-V <sub>EBO</sub>	max.	5	5	<b>V</b>
Collector current (d.c.)	-Ic	max.		500	mA
Collector current (peak value)	−I <sub>CM</sub>	max.		000	mΑ
Emitter current (peak value)	I <sub>EM</sub>	max.	10	000	mA
Base current (d.c.)	−l <sub>B</sub>	max.		100	mA
Base current (peak value)	-I <sub>BM</sub>	max.		200	mA
Total power dissipation up to $T_{amb} = 25  {}^{\circ}C^*$	P <sub>tot</sub>	max.		425	mW
Storage temperature	T <sub>stg</sub>		-65 to +	175	оС
Junction temperature	Tj	max.		175	оС
THERMAL CHARACTERISTICS**					
$T_j = P(R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab	R <sub>th j-t</sub>	- = -		30	K/W
From tab to soldering points	R <sub>th t-s</sub>	= "		260	K/W
From soldering points to ambient*	R <sub>th s-a</sub>			60	K/W
CHARACTERISTICS					
T <sub>i</sub> = 25 °C unless otherwise specified					
Collector cut-off current IE = 0; -V <sub>CB</sub> = 20 V	-Ісво	<		100	nΑ
$I_E = 0$ ; $-V_{CB} = 20 \text{ V}$ ; $T_i = 150 ^{\circ}\text{C}$	-I <sub>CBO</sub>	<		5	μΑ
Emitter cut-off current IC = 0; -VEB = 5 V		*; *; *		10	
Base-emitter voltage ▲	−I <sub>ЕВО</sub>			10	μΑ
-I <sub>C</sub> = 500 mA; -V <sub>CE</sub> = 1 V	-V <sub>BE</sub>	<		1,2	V
Saturation voltage $-I_C = 500 \text{ mA}$ ; $-I_B = 50 \text{ mA}$	-V <sub>CEsat</sub>	<		620	mV

<sup>\*</sup> Mounted on a ceramic substrate of 15 mm x 15 mm x 0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

<sup>■ -</sup>V<sub>BE</sub> decreases by about 2 mV/°C with increasing temperature.

70

40

8 pF

D.C. current gain  $-I_C = 100 \text{ mA}; -V_{CF} = 1 \text{ V}$ 100 to 600 hFF  $-I_C = 300 \text{ mA}; -V_{CE} = 1 \text{ V}$ hFE >  $-I_C = 500 \text{ mA}; -V_{CE} = 1 \text{ V}$ > hFE Transition frequency at f = 35 MHz  $-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$ fT 100 MHz typ. Collector capacitance at f = 1 MHz  $I_E = I_e = 0; -V_{CB} = 10 \text{ V}$  $C_{c}$ typ.

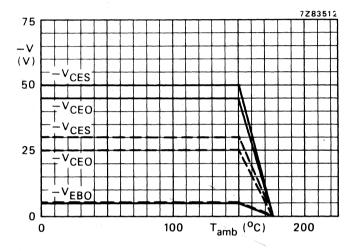


Fig. 2 Voltage derating curves. — — BCX18 — BCX17.

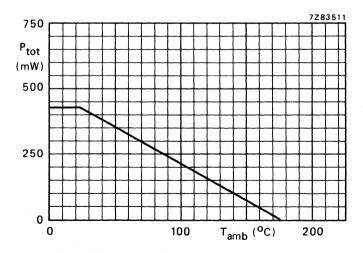


Fig. 3 Power derating curve.

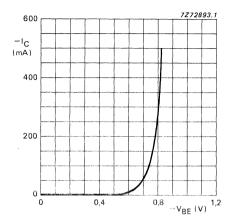


Fig. 4  $-V_{CE}$  = 1 V;  $T_j$  = 25 °C; typical values.

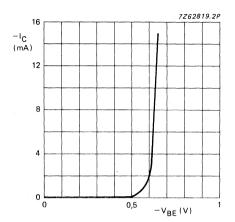


Fig. 5  $V_{CE}$  = 5 V;  $T_j$  = 25  $^{\rm o}$ C; typical values.

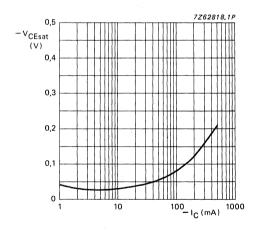


Fig. 6 I  $_{C}/I_{B}$  = 10; T  $_{j}$  = 25  $^{o}$ C; typical values.

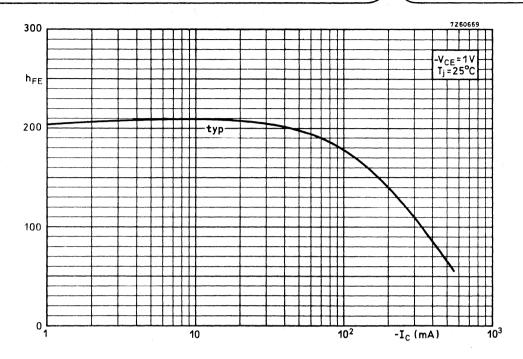


Fig. 7.

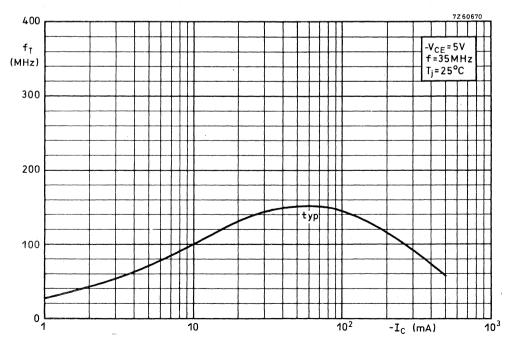
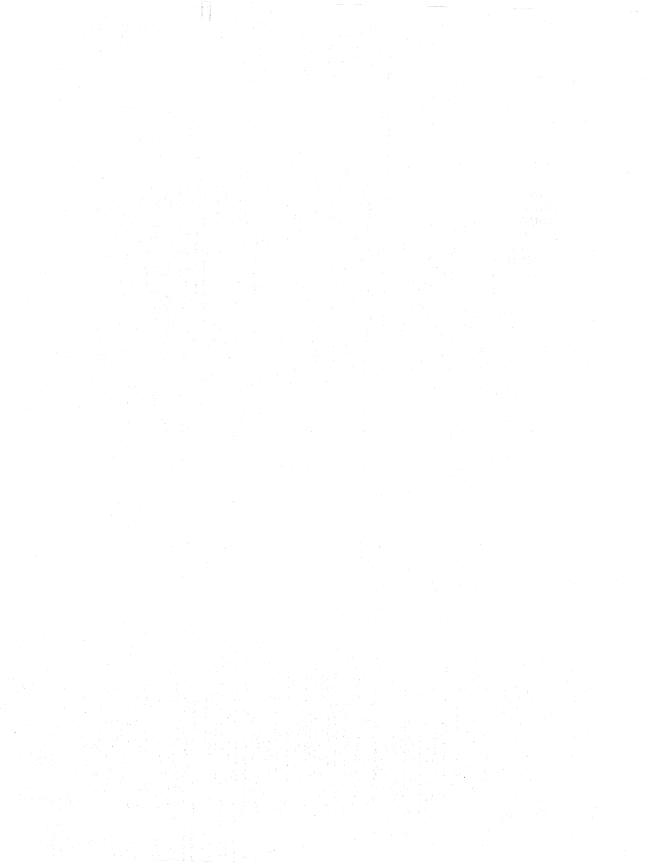


Fig. 8.

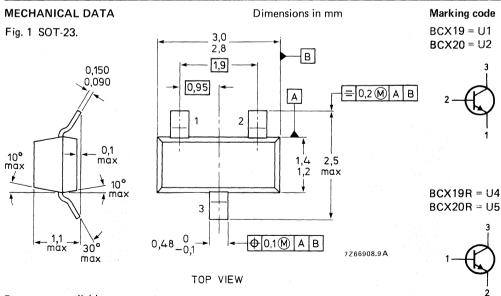


N-P-N transistors, in a SOT-23 plastic envelope, intended for application in thick and thin-film circuits. These transistors are intended for general purposes as well as saturated switching and driver applications for industrial service.

P-N-P complements are BCX17 and BCX18 respectively.

### QUICK REFERENCE DATA

			BCX19	BCX20	_
Collector-emitter voltage (V <sub>RF</sub> = 0)	$V_{CES}$	max.	50	30	V
Collector-emitter voltage (open base)	V <sub>CEO</sub>	max.	45	25	V
Collector current (peak value)	ICM	max.	1	000	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.		425	mW
Junction temperature	Ti	max.		175	оС
D.C. current gain $I_C = 100 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE		100 to	600	
Transition frequency $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 35 \text{ MHz}$	f <sub>T</sub>	typ.		200	MHz



R-types are available on request.

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Ç			BCX19	BCX20	
Collector-emitter voltage (V <sub>BE</sub> = 0) (see Fig. 2)	V <sub>CES</sub>	max.	50	30	V
Collector-emitter voltage (open base)				and of the	
$I_C = 10 \text{ mA (see Fig. 2)}$	$V_{CEO}$	max.	45	25	V
Emitter-base voltage (open collector) (see Fig. 2)	$V_{EBO}$	max.	5	5	V
Collector current (d.c.)	Ic	max.		500	mA
Collector current (peak value)	<sup>I</sup> CM	max.	1	000	mΑ
Emitter current (peak value)	$-I_{EM}$	max.	1	000	mΑ
Base current (d.c.)	ΙΒ	max.		100	mΑ
Base current (peak value)	<sup>I</sup> вм	max.		200	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C*	$P_{tot}$	max.		425	mW
Storage temperature	T <sub>stq</sub>		-65 to +	175	oC
Junction temperature	Tj	max.		175	oC
THERMAL CHARACTERISTICS**					
$T_j = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab	R <sub>th i-t</sub>	=		30	K/W
From tab to soldering points	R <sub>th t-s</sub>	=		260	K/W
From soldering points to ambient*	R <sub>th s-a</sub>	=		60	K/W
CHARACTERISTICS					
T <sub>i</sub> = 25 °C unless otherwise specified					
Collector cut-off current					
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$	ІСВО	<		100	nΑ
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$ ; $T_j = 150 \text{ °C}$	Ісво	<		5	$\mu A$
Emitter cut-off current					
$I_C = 0$ ; $V_{EB} = 5 V$	IEBO	<		10	μΑ
Base emitter voltage $\triangle$ I <sub>C</sub> = 500 mA; V <sub>CE</sub> = 1 V	V <sub>BE</sub>	<		1,2	V
Saturation voltage $I_C = 500 \text{ mA}$ ; $I_B = 50 \text{ mA}$	V <sub>CEsat</sub>	<		620	mV

<sup>\*</sup> Mounted on a ceramic substrate of 15 mm  $\times$  15 mm  $\times$  0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

<sup>▲</sup> V<sub>BE</sub> decreases by about 2 mV/°C with increasing temperature.

D.C. current gain  $I_C = 100$  mA;  $V_{CE} = 1$  V  $I_C = 300$  inA;  $V_{CE} = 1$  V  $I_C = 500$  mA;  $V_{CE} = 1$  V Transition frequency at f = 35 MHz  $I_C = 10$  mA;  $V_{CE} = 5$  V Collector capacitance at f = 1 MHz  $I_E = I_e = 0$ ;  $V_{CB} = 10$  V

h<sub>FE</sub> 100 to 600 h<sub>FE</sub> > 70 h<sub>FE</sub> > 40

f<sub>T</sub> typ. 200 MHz

C<sub>C</sub> typ. 5 pF

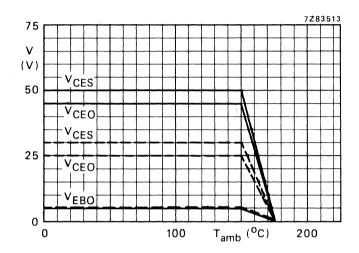


Fig. 2 Voltage derating curves. — — BCX19/BCX20 ——.

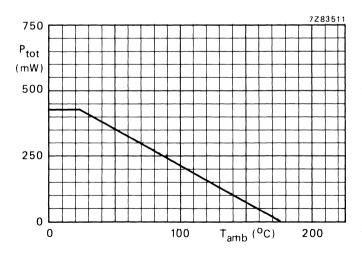


Fig. 3 Power derating curve.

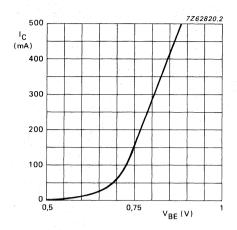


Fig. 4  $V_{CE}$  1 V;  $T_j$  =25  $^{o}$ C; typical values.

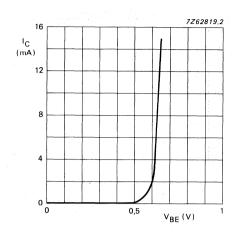


Fig. 5  $V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \text{ °C}$ ; typical values.

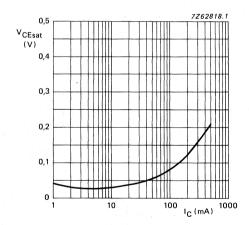


Fig. 6  $I_C/I_B = 10$ ;  $T_j = 25$   $^{o}C$ ; typical values.

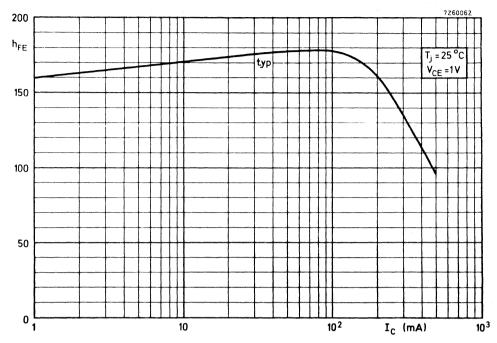


Fig. 7.

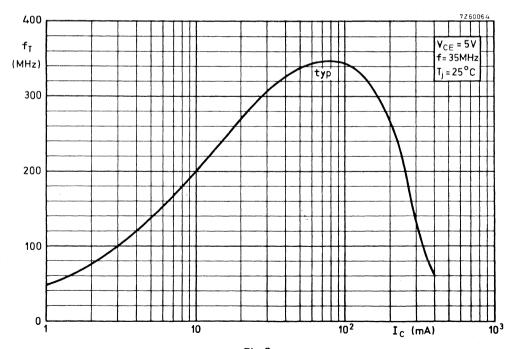


Fig. 8.

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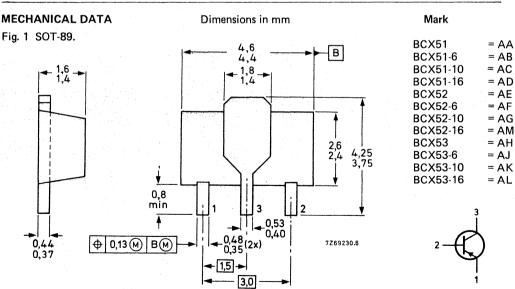
## SILICON PLANAR EPITAXIAL TRANSISTORS

Medium power p-n-p transistors in a miniature plastic envelope intended for applications in thick and thin-film circuits. These transistors are intended for general purposes as well as for use in driver stages of audio amplifiers.

N-P-N complements are BCX54, BCX55 and BCX56 respectively.

#### **QUICK REFERENCE DATA**

		ВС	45 60 45 60 45 60 1,5	BCX53		
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	45	60	100	V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	45	60	80	٧
Collector-emitter voltage (R <sub>BE</sub> = 1 k $\Omega$ )	-V <sub>CER</sub>	max.	45	60	100	٧
Collector current (peak value)	-I <sub>CM</sub>	max.		1,5		Α
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.		1		W
Junction temperature	$T_{j}$	max.		150		οС
D.C. current gain $-I_C = 150 \text{ mA}$ ; $-V_{CE} = 2 \text{ V}$	hFE		4	0 to 250		
Transition frequency at f = 35 MHz $-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	fT	typ.		50		МН

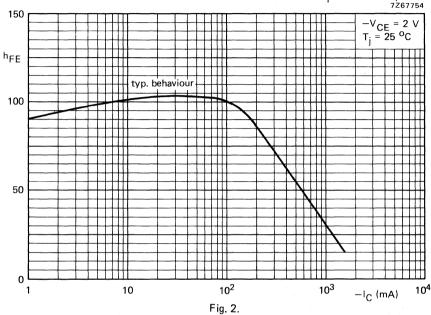


BOTTOM VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance with the Absolute	waximum sy	stem (ie	U 134)	1	ı	
		BC	X51	BCX52	BCX53	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	45	60	100	٧
Collector-emitter voltage (open base)	-VCEO	max.	45	60	80	٧
Collector-emitter voltage ( $R_{BE} = 1 \text{ k}\Omega$ )	-V <sub>CER</sub>	max.	45	60	100	٧
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	٧
Collector current (d.c.)	-I <sub>C</sub>	max.		1,0		Α
Collector current (peak value)	-I <sub>CM</sub>	max.		1,5		Α
Base current (d.c.)	-I <sub>B</sub>	max.		0,1		Α
Base current (peak value)	−l <sub>BM</sub>	max.		0,2		Α
Total power dissipation up to T <sub>amb</sub> = 25 °C mounted on a ceramic substrate area = 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	P <sub>tot</sub>	max.		1,0		w
Storage temperature	T <sub>stq</sub>		-65	to + 150		оС
Junction temperature	Tj	max.		150		оС
THERMAL RESISTANCE						
From junction to collector tab	R <sub>th j-tab</sub>	=		10		K/W
From junction to ambient in free air	,					
mounted on a ceramic substrate area = 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	R <sub>th j-a</sub>	=		125		K/W
CHARACTERISTICS						
T <sub>amb</sub> = 25 °C unless otherwise specified						
Collector cut-off current I <sub>E</sub> = 0; -V <sub>CB</sub> = 30 V	−l <sub>CBO</sub>	<		100		nA
I <sub>E</sub> = 0; -V <sub>CB</sub> = 30 V; T <sub>i</sub> = 125 °C	-Ісво	<		10		μΑ
Emitter cut-off current						
$I_C = 0; -V_{EB} = 5 V$	-IEBO	<		10		μΑ
Base-emitter voltage $-I_C = 500 \text{ mA}; -V_{CE} = 2 \text{ V}$	-V <sub>BE</sub>	<		1		V
Saturation voltage $-I_C = 500 \text{ mA}$ ; $-I_B = 50 \text{ mA}$	-V <sub>CEsat</sub>	<		0,5		v
D.C. current gain						
$-I_C = 5 \text{ mA}; -V_{CE} = 2 \text{ V}$	hFE	>		25		
$-I_C = 150 \text{ mA}; -V_{CE} = 2 \text{ V}$	hFE		4	0 to 250		
-I <sub>C</sub> = 500 mA; -V <sub>CE</sub> = 2 V	hFE	>		25		
Transition frequency at f = 35 MHz $-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	f <sub>T</sub> ,	typ.		50		MHz

CHARACTERISTICS (continued)	ACTERISTICS (continued) BCX51-6 52-6				
			53-6	53-10	53-16
D.C. current gain $-I_C = 150 \text{ mA}; -V_{CE} = 2 \text{ V}$	hFE	> <	40 100	63 160	100 250



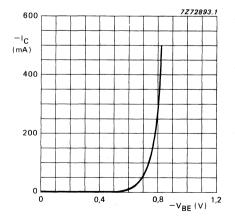


Fig. 3  $-V_{CE}$  = 2 V;  $T_j$  = 25 °C; typical values.

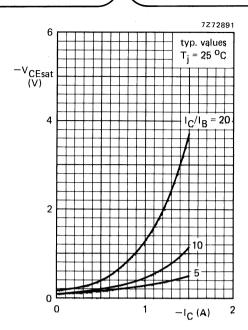


Fig. 4.

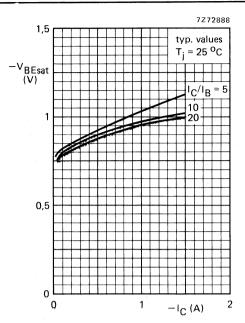


Fig. 5.

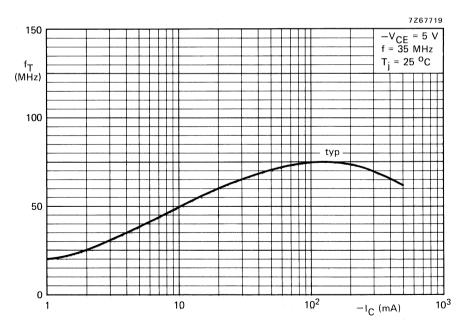


Fig. 6.

332

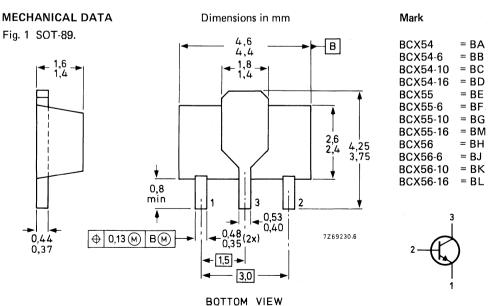
### SILICON PLANAR EPITAXIAL TRANSISTORS

Medium power n-p-n transistors in a miniature plastic envelope intended for applications in thick and thin-film circuits. These transistors are intended for general purposes as well as for use in driver stages of audio amplifiers.

P-N-P complements are BCX51, BCX52 and BCX53 respectively.

#### QUICK REFERENCE DATA

		ВС	CX54	BCX55	BCX56	
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	45	60	100	٧
Collector-emitter voltage (open base)	VCEO	max.	45	60	80	V
Collector-emitter voltage (R <sub>BE</sub> = 1 k $\Omega$ )	$v_{CER}$	max.	45	60	100	V
Collector current (peak value)	ICM	max.		1,5		Α
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.		1		W
Junction temperature	$T_{i}$	max.		150		οС
D.C. current gain $I_C = 150 \text{ mA}$ ; $V_{CE} = 2 \text{ V}$	hFE		4	10 to 250		
Transition frequency at f = 35 MHz $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.		130		MH



Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limitii	ng values in accordance with the Absolute I	Maximum Sys	tem (IE)	C 134)	ì	1	
			BC	X54	BCX55	BCX56	•
Collect	or-base voltage (open emitter)	$v_{CBO}$	max.	45	60	100	V
Collect	or-emitter voltage (open base)	V <sub>CEO</sub>	max.	45	60	80	V
Collect	or-emitter voltage (R <sub>BE</sub> = 1 k $\Omega$ )	V <sub>CER</sub>	max.	45	60	100	$\mathbf{V}$
Emitte	r-base voltage (open collector)	V <sub>EBO</sub>	max.	5	5	5	V
Collect	or current (d.c.)	IC	max.		1,0	3 5	Α
Collect	or current (peak value)	I <sub>CM</sub>	max.		1,5		Α
Base cu	urrent (d.c.)	I <sub>B</sub>	max.		0,1		Α
Base cu	urrent (peak value)	I <sub>BM</sub>	max.		0,2		Α
mou	power dissipation up to T <sub>amb</sub> = 25 °C on the on a ceramic substrate						
area	= 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	P <sub>tot</sub>	max.		1,0		W
Storage	e temperature	T <sub>stg</sub>		65	to +150		оС
Junctio	on temperature	$T_{j}$	max.		150		oC .
THERI	MAL RESISTANCE						
From j	unction to collector tab	R <sub>th j-tab</sub>	= 2 2 2 2		10		K/W
mou	unction to ambient in free air nted on a ceramic substrate						
area	= 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	R <sub>th j-a</sub>	=		125		K/W
CHAR	ACTERISTICS						
T <sub>amb</sub> =	= 25 °C unless otherwise specified						
	or cut-off current						
	0; V <sub>CB</sub> = 30 V	ICBO	<		100		nA
IE =	0; $V_{CB} = 30 \text{ V}$ ; $T_j = 125 ^{\circ}\text{C}$	ICBO	<		10		μΑ
	r cut-off current 0; V <sub>EB</sub> = 5 V	I <sub>EBO</sub>	<		10		μΑ
Base-er	nitter voltage						
IC =	$500 \text{ mA}$ ; $V_{CE} = 2 \text{ V}$	$V_{BE}$	<		1		٧
	tion voltage 500 mA; I <sub>B</sub> = 50 mA	V <sub>CEsat</sub>	<		0,5		V
	ırrent gain	OLSat			• •		
	5 mA; V <sub>CE</sub> = 2 V	hFE	>		25		
I <sub>C</sub> =	150 mA; V <sub>CE</sub> = 2 V	hFE		4	0 to 250		
I <sub>C</sub> =	500 mA; $V_{CE} = 2 V$	hFE	> 1		25		
	ion frequency at f = 35 MHz 10 mA; V <sub>CE</sub> = 5 V	fΤ	typ.		130		MHz
		1	-, p.		100		.,,,,,

CHARACTERISTICS (continued)		BXC54-6 55-6 56-6	BCX54-10 55-10 56-10	BCX54-16 55-16 56-16
D.C. current gain I <sub>C</sub> = 150 mA; V <sub>CE</sub> = 2 V	hFE <	40 100	63 160	100 250
150			V <sub>CE</sub>	7267755 = 2 V 25 °C
hFE				
100	typ. beł	naviour		
50				
0 1 10	10 <sup>2</sup>		10 <sup>3</sup> 1 <sub>C</sub> (mA	10 <sup>4</sup>

Fig. 2.

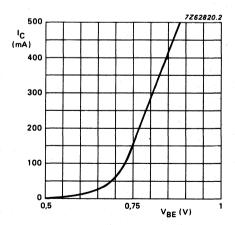


Fig. 3  $V_{CE}$  = 2 V;  $T_j$  = 25  $^{o}$ C; typical values.

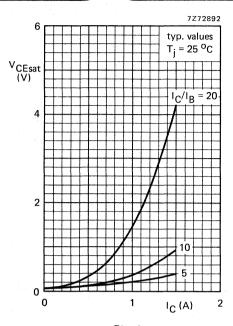


Fig. 4.

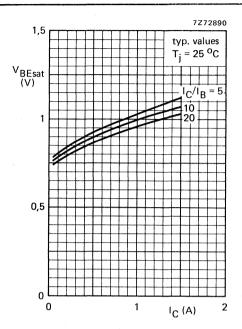


Fig. 5.

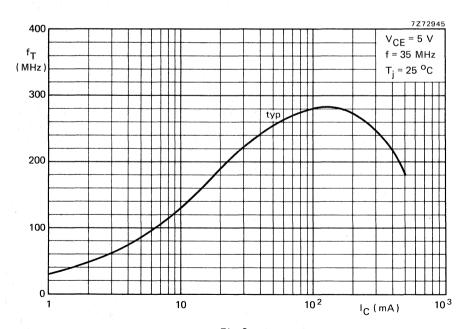


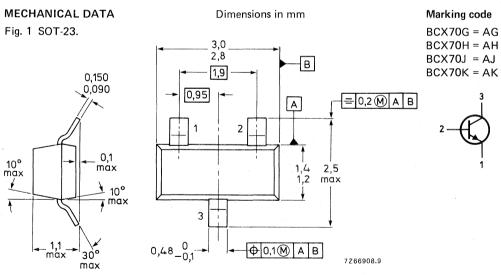
Fig. 6.

# SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistors, in a microminiature plastic envelope, intended for low level, low noise, low frequency purpose applications in hybrid circuits.

#### **QUICK REFERENCE DATA**

Collector-emitter voltage (V <sub>BE</sub> = 0)	V <sub>CES</sub>	max.	45 V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	45 V
Collector current (d.c.)	Ic	max.	200 mA
Total power dissipation	P <sub>tot</sub>	max.	150 mW
Junction temperature	Ti	max.	150 °C
Transition frequency at f = 100 MHz	•		
$V_{CE} = 5 \text{ V; } I_{C} = 10 \text{ mA}$	$_{ m f}$	typ.	250 MHz
Noise figure at f = 1 kHz	_		
V <sub>CE</sub> = 5 V; I <sub>C</sub> = 200 μA; B = 200 Hz	F	typ.	2 dB



TOP VIEW

ha i indo					
Limiting values in accordance with the Absolute Maximum System (IE	C 134)				
Collector-emitter voltage (V <sub>BE</sub> = 0)	V <sub>CES</sub>	max.	45	V	
Collector-emitter voltage (open base)	VCEO	max.	45	٧	
Emitter-base voltage (open collector)	$V_{EBO}$	max.	5	V	
Collector current (d.c.)	IC	max.	200	mΑ	
Base current	I <sub>B</sub>	max.	50	mΑ	
Total power dissipation up to T <sub>amb</sub> = 100 °C**	P <sub>tot</sub>	max.	150	mW	
Storage temperature	T <sub>stg</sub>	-55 to +	125	oC	
Junction temperature	$T_{j}$	max.	150	оС	
THERMAL CHARACTERISTICS*					
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab	R <sub>th j-t</sub>	= -	50	K/W	
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W	
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W	
CHARACTERISTICS					
T <sub>amb</sub> = 25 °C unless otherwise specified					
Collector-emitter cut-off current  VBE = 0; VCE = 45 V	ICES	<	20	nA	
V <sub>BE</sub> = 0; V <sub>CE</sub> = 45 V; T <sub>amb</sub> = 150 °C	ICES	<	20	μΑ	
Emitter-base cut-off current I <sub>C</sub> = 0; V <sub>EB</sub> = 4 V	I <sub>EBO</sub>	<	20	nA	
Saturation voltages					
at $I_C = 10 \text{ mA}$ ; $I_B = 0.25 \text{ mA}$	$v_{CEsat}$	0,05 to			
	$V_{BEsat}$	0,6 to			
at $I_C = 50 \text{ mA}$ ; $I_B = 1,25 \text{ mA}$	V <sub>CEsat</sub>	0,1 to			
	<b>V</b> BEsat	0,7 to	1,05	V	
Transition frequency at f = 100 MHz ▲  I <sub>C</sub> = 10 mA; V <sub>CF</sub> = 5 V	f <sub>T</sub>	>		MHz	
	•	typ.	250	MHz	
Collector capacitance at f = 1 MHz I <sub>E</sub> = I <sub>e</sub> = 0; V <sub>CB</sub> = 10 V	C <sub>c</sub>	typ.	2,5	рF	
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0$ ; $V_{EB} = 0.5 \text{ V}$	C <sub>e</sub>	typ.	8	pF	
Noise figure at R <sub>S</sub> = 2 k $\Omega$ I <sub>C</sub> = 200 $\mu$ A; V <sub>CE</sub> = 5 V; f = 1 kHz; B = 200 Hz	F	typ.		dB dB	
		`	J	ab .	

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

<sup>▲</sup> Measured under pulse conditions.

			G	Н	J	K	
D.C. current gain $V_{CE} = 5 \text{ V}$ ; $I_{C} = 10 \mu \text{A}$	hFE	typ.	78 —	145 20	220 40	300 100	
V <sub>CE</sub> = 5 V; I <sub>C</sub> = 2 mA	hFE	> typ. <	120 170 220	180 250 310	250 350 460	380 500 630	
$V_{CE} = 1 V; I_{C} = 50 \text{ mA}$	hFE	>	50	70	90	100	
Input impedance $V_{CE} = 5 \text{ V}$ ; $I_{C} = 2 \text{ mA}$ ; $f = 1 \text{ kHz}$	h <sub>ie</sub>	typ.	2,7	3,6	4,5	7,5 k	·Ω •
Reverse voltage transfer ratio $V_{CE} = 5 \text{ V}; I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>re</sub>	typ.	1,5	2	2	3 1	10 <sup>-4</sup>
Small-signal current gain $V_{CE} = 5 \text{ V}; I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>fe</sub>	typ.	200	260	330	520	-
Output admittance $V_{CE} = 5 \text{ V}; I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>oe</sub>	typ.	18	24	30	50 μ	ıS 📥
Base-emitter voltage			0.1	55 to 0,	75		V
$V_{CE} = 5 \text{ V}; I_{C} = 2 \text{ mA}$	VBE	typ.	Ο,.	0,i			v V
$V_{CE} = 5 \text{ V}; I_{C} = 10 \mu \text{A}$	$V_{BE}$	typ.		0,	52	١	V
$V_{CE} = 1 \text{ V; } I_{C} = 50 \text{ mA}$	$V_{BE}$	typ.		0,	78	\	V

# **BCX70 SERIES**

### Switching times

 $\begin{array}{c} I_{Con} = 10 \text{ mA; } I_{Bon} = -I_{Boff} = 1 \text{ mA} \\ V_{CC} = 10 \text{ V; } R_L = 990 \ \Omega \\ \\ turn\text{-on time } (t_d + t_r) \\ \\ turn\text{-off time } (t_s + t_f) \\ \end{array} \qquad \begin{array}{c} t_{yp.} & 85 \text{ ns} \\ < & 150 \text{ ns} \\ \\ t_{off} & < 80 \text{ ns} \\ \end{array}$ 

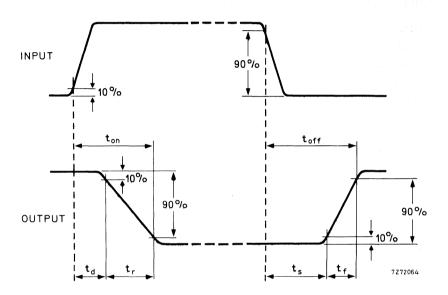


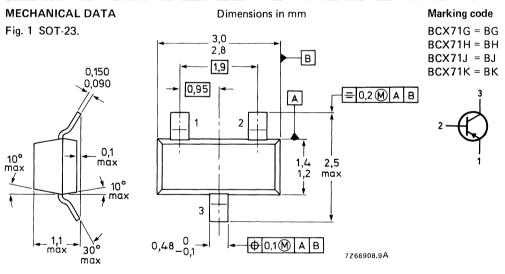
Fig. 2 Switching waveforms.

# SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon transistors, in a microminiature plastic envelope, intended for low level, low noise, low frequency purpose applications in hybrid circuits.

#### QUICK REFERENCE DATA

Collector-emitter voltage (V <sub>BE</sub> = 0)	-V <sub>CES</sub>	max.	45 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	45 V
Collector current (d.c.)	-1C	max.	200 mA
Total power dissipation	$P_{tot}$	max.	150 mW
Junction temperature	$T_{j}$	max.	150 °C
Transition frequency at f = 100 MHz $-V_{CE}$ = 5 V; $-I_{C}$ = 10 mA	f <sub>T</sub>	typ.	180 MHz
Noise figure at f = 1 kHz $-V_{CE}$ = 5 V; $-I_{C}$ = 200 $\mu$ A	F	typ.	2 dB



TOP VIEW

# **BCX71 SERIES**

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134) Collector-emitter voltage ( $V_{BF} = 0$ ) 45 V -VCES max. Collector-emitter voltage (open base)  $-V_{CEO}$ 45 V max. Emitter-base voltage (open collector) 5 V -V<sub>FRO</sub> max. Collector current (d.c.) 200 mA -1cmax. Base current  $-I_{R}$ max. 50 mA Total power dissipation up to Tamb = 100 °C \*\* 150 mW P<sub>tot</sub> max. Storage temperature Tsta -55 to + 125 °C Junction temperature 150 °C max. Τį

### THERMAL CHARACTERISTICS\*

 $T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

#### Thermal resistance

From junction to tab  $R_{th \ j \cdot t} = 50 \ \text{K/W}$  From tab to soldering points  $R_{th \ t \cdot s} = 280 \ \text{K/W}$  From soldering points to ambient\*\*  $R_{th \ s \cdot a} = 90 \ \text{K/W}$ 

### CHARACTERISTICS

T<sub>amb</sub> = 25 °C unless otherwise specified
Collector-emitter cut-off current

V<sub>EB</sub> = 0; -V<sub>CE</sub> = 45 V

 $V_{EB} = 0$ ;  $-V_{CE} = 45 \text{ V}$ ;  $T_{amb} = 150 \text{ °C}$ 

Emitter-base cut-off current  $I_C = 0$ ;  $-V_{FB} = 4 V$ 

Saturation voltages  $-I_C = 10 \text{ mA}; -I_B = 0.25 \text{ mA}$ 

 $-I_C = 10 \text{ mA}; -I_B = 0.25 \text{ mA}$ 

 $-I_C = 50 \text{ mA}; -I_B = 1,25 \text{ mA}$ 

Transition frequency at f = 100 MHz ▲

 $-V_{CE} = 5 \text{ V}; -I_{C} = 10 \text{ mA}$ Collector capacitance at f = 1 MHz

Collector capacitance at f = 1 MHz

-V<sub>CB</sub> = 10 V; I<sub>E</sub> = I<sub>e</sub> = 0

Emitter capacitance at f = 1 MHz

 $-V_{EB} = 0.5 \text{ V}; I_{C} = I_{c} = 0$ Noise figure at  $R_{S} = 2 \text{ k}\Omega$ 

 $-V_{CE} = 5 \text{ V}; -I_{C} = 200 \mu\text{A}; B = 200 \text{ Hz}$ 

C<sub>c</sub>

fΤ

-ICES

-ICES

-lebo

−V<sub>CEsat</sub> −V<sub>BEsat</sub>

-V<sub>CEsat</sub>

-V<sub>BEsat</sub>

typ.

<

typ.

yp. 4,5 pF yp. 11 pF

0.06 to 0.25 V

0,6 to 0,85 V

0,12 to 0,55 V 0,68 to 1,05 V

20 nA

20 μA

20 nA

180 MHz

typ. 2 dB < 6 dB

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Measured under pulse conditions.

			G	Н	J	Κ	
D.C. current gain		typ.	140	200	270	340	
$-V_{CE} = 5 \text{ V}; -I_{C} = 10 \mu \text{A}$	hFE	>	_	30	40	100	
		>	120	180	250	380	
$-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}$	hFE	typ.	170 220	250 310	350 460	630	
$-V_{CE} = 1 \text{ V}; -I_{C} = 50 \text{ mA}$	hFE	>	60	80	100	110	
Input impedance							
$-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>ie</sub>	typ.	2,7	3,6	4,5	7,5 kΩ	
Reverse voltage transfer ratio							
$-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>re</sub>	typ.	1,5	2	2	3 10-4	
Small-signal current gain							
$-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>fe</sub>	typ.	200	260	330	520	
Output admittance							
$-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}; f = 1 \text{ kHz}$	h <sub>oe</sub>	typ.	18	24	30	50 μS	
Base-emitter voltage				) 6 to 0	75	<u>.</u> V	
$-V_{CE} = 5 \text{ V}; -I_{C} = 2 \text{ mA}$	$V_{BE}$	typ.		),6 to 0, ,0	75 65	· · · V	
$-V_{CE} = 5 \text{ V}; -I_{C} = 10 \mu \text{A}$	$v_{BE}$	typ.			55	V	
$-V_{CF} = 1 \text{ V}; -I_{C} = 50 \text{ mA}$	VRE	typ.		0,	72	V	

# **BCX71 SERIES**

# Switching times

$$-I_{Con} = 10 \text{ mA}; -I_{Bon} = I_{Boff} = 1 \text{ mA}$$
  
 $-V_{CC} = 10 \text{ V}; R_L = 990 \Omega$ 

turn-on time  $(t_d + t_r)$ 

turn-off time (t<sub>s</sub> + t<sub>f</sub>)

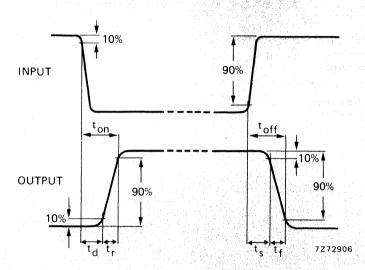


Fig. 2 Switching waveforms.

# N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

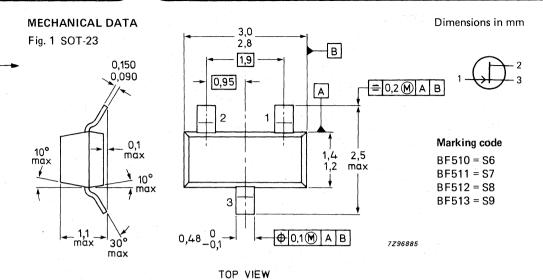
Asymmetrical N-channel planar epitaxial junction field-effect transistors in the miniature plastic envelope intended for applications up to the v.h.f. range in hybrid thick and thin-film circuits. Special features are the low feedback capacitance and the low noise figure. These features make the product very suitable for applications such as the r.f. stages in f.m. portables (BF510), car radios (BF511) and mains radios (BF512) or the mixer stage (BF513).

### QUICK REFERENCE DATA

Drain-source voltage	V <sub>DS</sub>	max.			20	٧
Drain current (d.c. or average)	מי	max.			30	mA
Total power dissipation up to T <sub>amb</sub> = 65 °C	P <sub>tot</sub>	max.			250	mW
경기 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 : 1 :		В	F510	511	512	513
Drain current $V_{DS} = 10 \text{ V}; V_{GS} = 0$	IDSS	> <	0,7 3,0	2,5 7,0	6 12	10 mA 18 mA
Transfer admittance (common source) VDS = 10 V; VGS = 0; f = 1 kHz	y <sub>fs</sub>	>	2,5	4	6	7 mS
Feedback capacitance V <sub>DS</sub> = 10 V; V <sub>GS</sub> = 0	C <sub>rs</sub>	typ.	0,3	0,3	-	– pF
$V_{DS} = 10 \text{ V; I}_{D} = 5 \text{ mA}$	Crs	typ.	<del>}</del>		0,3	0,3 pF
Noise figure at optimum source admittance $G_S = 1 \text{ mS}$ ; $-B_S = 3 \text{ mS}$ ; $f = 100 \text{ MHz}$						
$V_{DS} = 10 \text{ V}; V_{GS} = 0$	F	typ.	1,5	1,5		– dB
$V_{DS} = 10 \text{ V}; I_{D} = 5 \text{ mA}$	F	typ.	_	_	1,5	1,5 dB

#### **MECHANICAL DATA**

SOT-23.



Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage see Fig. 4	$V_{DS}$	max.	20 V
Drain-gate voltage (open source) see Fig. 4	$V_{DGO}$	max.	20 V
Drain current (d.c. or average)	ID	max.	30 mA
Gate current	± IG	max.	10 mA
Total power dissipation up to $T_{amb} = 60  {}^{\circ}C^{**}$	P <sub>tot</sub>	max.	250 mW
Storage temperature range	T <sub>stg</sub>	-65 to +	- 175 °C
Junction temperature	$T_{j}$	max.	175 °C

#### THERMAL CHARACTERISTICS\*

$$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$

### Thermal resistance

· · · · · · · · · · · · · · · · · · ·				
From junction to tab	R <sub>th j-t</sub>	=	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W

- \* See Thermal characteristics.
- \*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

### STATIC CHARACTERISTICS

		BF510	511	512	513
−l <sub>GSS</sub>	<	10	10	10	10 nA
−V(BR)GDO	>	20	20	20	20 V
DSS	> <	0,7 3,0	2,5 7,0	6 12	10 mA 18 mA
−V(P)GS	typ.	0,8	1,5	2,2	3 V
	−V(BR)GDO IDSS	-V <sub>(BR)GDO</sub> >	-I <sub>GSS</sub> < 10 -V <sub>(BR)GDO</sub> > 20 -V <sub>(BR)GDO</sub> > 0,7 -V <sub>(BR)GDO</sub> > 3,0	-I <sub>GSS</sub> < 10 10 -V <sub>(BR)GDO</sub> > 20 20 I <sub>DSS</sub> > 0,7 2,5 3,0 7,0	-I <sub>GSS</sub> < 10 10 10 10 -V <sub>(BR)GDO</sub> > 20 20 20 10 10 10 10 10 10 10 10 10 10 10 10 10

#### DYNAMIC CHARACTERISTICS

Measuring conditions (common source):  $V_{DS} = 10 \text{ V}$ ;  $V_{GS} = 0$ ;  $T_{amb} = 25 \text{ °C}$  for BF510 and BF511  $V_{DS} = 10 \text{ V}$ ;  $I_D = 5 \text{ mA}$ ;  $T_{amb} = 25 \text{ °C}$  for BF512 and BF513

y-parameters (common source)			BF510	511	512	513
Input capacitance at f = 1 MHz	C <sub>is</sub>	<	5	5	5	5 pF
Input conductance at f = 100 MHz	9is	typ.	100	90	60	50 μS
Feedback capacitance at f = 1 MHz	C <sub>rs</sub>	typ.	0,3 0,4	0,3 0,4	0,3 0,4	0,3 pF 0,4 pF
Transfer admittance at f = 1 kHz	yfs	>	2,5	4,0	4,0	3,5 mS
$V_{GS} = 0$ instead of $I_D = 5$ mA	yfs	>			6,0	7,0 mS
Transfer admittance at f = 100 MHz	yfs	typ.	3,5	5,5	5,0	5,0 mS
Output capacitance at f = 1 MHz	Cos	<	3	3	3	3 pF
Output conductance at f = 1 MHz	g <sub>os</sub>	<	60	80	100	120 μS
Output conductance at f = 100 MHz	gos	typ.	35	55	70	90 μS
Noise figure at optimum source admitt GS = 1 mS; -BS = 3 mS;	4.15	1 =	1.5	1.5	1.5 dB	
f = 100 MHz	F	typ.	1,5	1,5	1,5	1,5 45

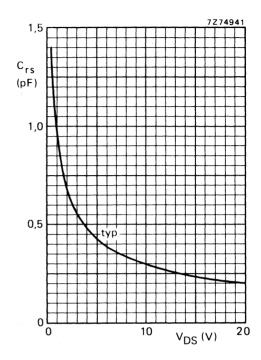


Fig. 2  $V_{GS}$  = 0 for BF510 and BF511; I<sub>D</sub> = 5 mA for BF512 and BF513; f = 1 MHz;  $T_{amb}$  = 25 °C.

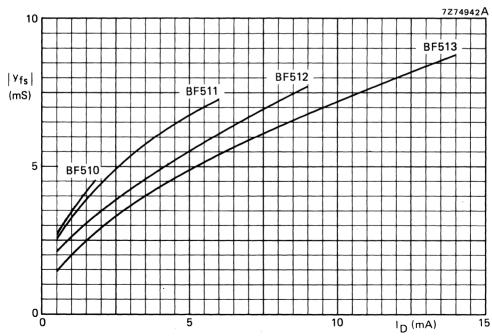


Fig. 3  $V_{DS}$  = 10 V; f = 1 kHz;  $T_{amb}$  = 25 °C; typical values.

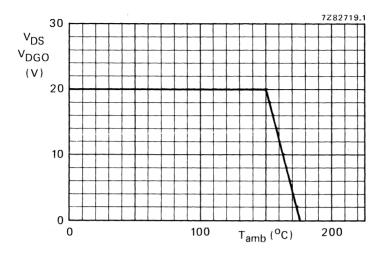


Fig. 4 Voltage derating curve.

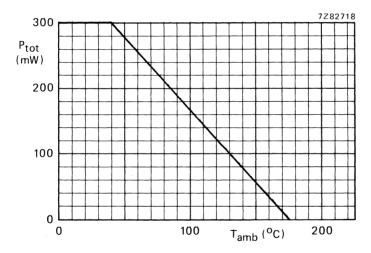


Fig. 5 Power derating curve.

Asimol Augustos

# SILICON PLANAR TRANSISTOR

P-N-P transistor in a microminiature plastic envelope. Primarily intended for use as mixer in v.h.f. tuners. Also suitable as r.f. amplifier and oscillator in f.m. tuners.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	30 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30 V
Collector current (d.c.)	$-I_{\mathbb{C}}$	max.	25 mA
Total power dissipation up to T <sub>amb</sub> = 60 °C	P <sub>tot</sub>	max.	200 mW
Junction temperature	Tį	max.	150 °C
D.C. current gain I <sub>E</sub> = 1 mA; -V <sub>CB</sub> = 10 V	hFE	>	25
Transition frequency at $f = 100 \text{ MHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 10 \text{ V}$	f <sub>T</sub>	typ.	350 MHz
Noise figure at $f = 200 \text{ MHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 10 \text{ V}$	F	typ.	5 dB

### **MECHANICAL DATA** Dimensions in mm Marking code Fig. 1 SOT-23. BF536 = G33,0 2,8 В 1.9 0,150 0,090 0,95 0,2 M A B 0,1 max 10° max

Ф 0,1(M)

2,5 max

7266908.9

TOP VIEW

3

See also Soldering recommendations.

30°

\_1,1 \_ max

<u> 10°</u> → max

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance with the Absolute Maximum System	II (III)	134/			
Collector-base voltage (open emitter)		-V <sub>CBO</sub>	max.	30	٧
Collector-emitter voltage (open base)		$-V_{CEO}$	max.	30	٧
Emitter-base voltage (open collector)		$-V_{EBO}$	max.	4	٧
Collector current (d.c.)		-I <sub>C</sub>	max.	25	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C **		P <sub>tot</sub>	max.	200	mW
Storage temperature		$T_{stg}$	65 to +	150	$^{\mathrm{o}}\mathrm{C}$

Τi

150 °C

25

350 MHz

max.

typ.

#### THERMAL CHARACTERISTICS\*

 $T_i = P(R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

# Thermal resistance

Junction temperature

From junction to tab  $R_{th j-t} = 60 \text{ K/W}$ From tab to soldering points  $R_{th t-s} = 280 \text{ K/W}$ From soldering points to ambient\*\*  $R_{th s-a} = 90 \text{ K/W}$ 

### **CHARACTERISTICS**

T<sub>amb</sub> = 25 °C; unless otherwise specified

Collector cut-off current  $I_E = 0; -V_{CB} = 20 \text{ V}$   $-I_{CBO} < 50 \text{ nA}$  D.C. current gain

 $I_E = 1 \text{ mA;} -V_{CB} = 10 \text{ V}$ 

Transition frequency at f = 100 MHz  $I_E = 1 \text{ mA}$ ;  $-V_{CB} = 10 \text{ V}$   $f_T$ 

Noise figure at f = 200 MHz  $I_E = 1 \text{ mA}; -V_{CB} = 10 \text{ V}; R_S = 50 \Omega$  F typ. 5 dB

Transducer gain (common base) at f = 200 MHz  $I_E$  = 3 mA;  $-V_{CB}$  = 10 V;  $R_S$  = 60  $\Omega$ ;  $R_L$  = 920  $\Omega$   $G_{tr}$  typ. 17,5 dB

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

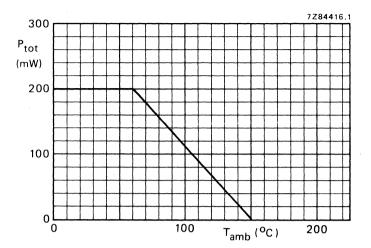


Fig. 2 Power derating curve.



# SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor, in a microminiature plastic envelope, intended for applications in thick and thin-film circuits. This transistor is primarily intended for use in i.f. detection applications.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40	V
Collector-emitter voltage (open base)	-VCEO	max.	40	V
Collector current (d.c.)	-IC	max.	25	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.	200	mW
Junction temperature	Ti	max.	150	oC
D.C. current gain at $T_j = 25$ °C $-I_C = 1$ mA; $-V_{CE} = 10$ V	hFE	> 1 1	50	
Transition frequency at $f = 100 \text{ MHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 10 \text{ V}$	f <sub>T</sub>	typ.	325	MHz
Noise figure at $R_S = 300 \Omega$ $-I_C = 1 \text{ mA}; -V_{CE} = 10 \text{ V}; f = 100 \text{ kHz}$	F	typ.	2	dB

#### **MECHANICAL DATA** Marking code Dimensions in mm Fig. 1 SOT-23 BF550 = G23,0 2,8 В 1,9 0,150 0,090 0,95 = 0,2 (M) A B Α 0,1 10° máx 1,4 2,5 max BF550R = G5 max <u>₹</u> 10° → max 3 1,1 max Φ 0,1(M) 30° 7Z66908.9 max TOP VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

- many raises in accertaines with the resolute maxima in cy	300111 (120 10	5 .,		
Collector-base voltage (open emitter)	-Усво	max.	40	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	40	V
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	4	<b>V</b> ,
Collector current (d.c.)	-I <sub>C</sub>	max.	25	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C **	$P_{tot}$	max.	200	mW
Storage temperature	T <sub>stg</sub>	-55 to	+150	оС
Junction temperature	Ti	max.	150	oC

#### THERMAL CHARACTERISTICS\*

 $T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

## Thermal resistance

From junction to tab	R <sub>th j-t</sub>	=	60 K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280 K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90 K/W

#### **CHARACTERISTICS**

T<sub>amb</sub> = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0; -V_{CB} = 30 \text{ V}$	-I <sub>CBO</sub>	<	50 nA
Emitter cut-off current			
$I_{C} = 0; -V_{EB} = 3 V$	-l <sub>EBO</sub>	<	100 μΑ

•	20			·-
Base-emitte	r voltage			
$-1_{C} = 1_{r}$	mA; –V <sub>CE</sub> = 10 V	-V <sub>BE</sub>	typ.	750 mV
D.C. curron	t goin			

D.C. current gain			
$-I_C = 1 \text{ mA; } -V_{CE} = 10 \text{ V}$	hFE	>	50
T 1:1 6 . 6 400 to 1			

transition frequency at f = 100 MHz			
$-I_C = 1 \text{ mA}; -V_{CE} = 10 \text{ V}$	fT	typ.	325 MHz
Feedback capacitance at f = 1 MHz			
•			

Feedback capacitance at f = 1 MHz			
$-I_C = 1 \text{ mA; } -V_{CE} = 10 \text{ V}$	C <sub>re</sub>	typ.	0,5 pF
Noise figure at R <sub>S</sub> = 300 $\Omega$			
$-1_C = 1 \text{ mA}; -V_{CE} = 10 \text{ V}; f = 100 \text{ kHz}$	F	typ.	2 dB

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

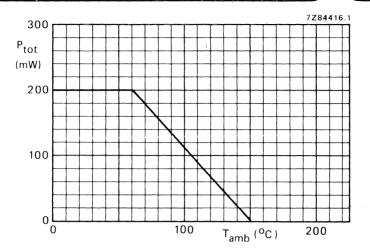


Fig. 2 Power derating curve.



# SILICON PLANAR EPITAXIAL TRANSISTOR

P-N-P transistor in a microminiature plastic envelope, intended for applications in thick and thin-film circuits such as self-oscillating mixer in u.h.f. tuners in conjunction with bipolar transistors or with MOS fets.

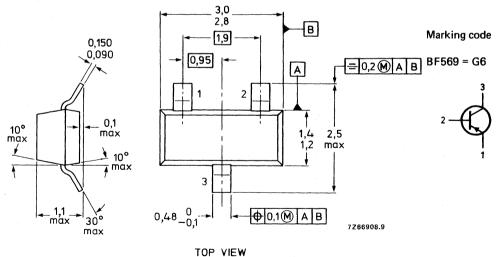
#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	35 V
Collector current (d.c )	−l <sub>C</sub>	max.	30 mA
Total power dissipation up to $T_{amb} = 60$ °C	P <sub>tot</sub>	max.	200 mW
Junction temperature	Τį	max.	150 °C
Transition frequency at f = 100 MHz	•		
$I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}$	fT	typ.	900 MHz

#### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOT-23



Limiting values in accordance with the Absolute Maximum System (	IEC 134)			
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	35	V ,
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	3	<b>V</b> ,
Collector current (d.c.)	-I <sub>C</sub>	max.	30	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C**	P <sub>tot</sub>	max.	200	mW
Storage temperature	T <sub>stg</sub>	-65 to +	150	οС
Junction temperature	$T_j$	max.	150	оС
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th i-t</sub>	±	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified.				
Collector cut-off current				
$I_E = 0; -V_{CB} = 20 \text{ V}$	<sup>−l</sup> CBO	<	100	nA
D.C. current gain	L	>	25	
$I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}$	hFE	typ.	50	
Transition frequency at f = 100 MHz				
$I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}$	fΤ	typ.	900	MHz
Feedback capacitance at f = 1 MHz  I <sub>E</sub> = 1 mA; -V <sub>CB</sub> = 10 V	C	tvn	0,33	n E
Noise figure at f = 800 MHz	C <sub>re</sub>	typ.	0,33	þr.
$I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}; R_S = 60 \Omega; R_L = 500 \Omega$	F	typ.	4,5	dB
Power gain at f = 800 MHz				
$I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}; R_S = 60 \Omega; R_L = 500 \Omega$	$G_{pb}$	typ.	14,5	dB

<sup>\*</sup> See Thermal characteristics. \*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

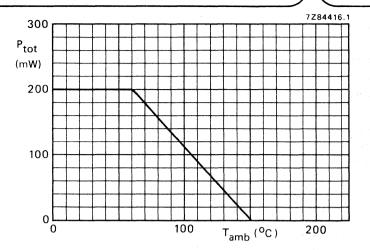


Fig. 2 Power derating curve.



# SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic SOT-23 variant envelope, intended for use in large-signal handling i.f. preamplifiers of TV receivers in combination with surface acoustic wave filters.

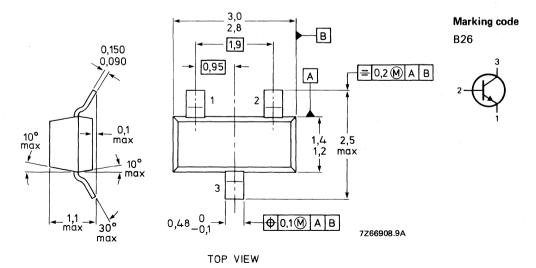
#### **QUICK REFERENCE DATA**

Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	40	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	15	٧
Collector current (d.c.)	IC	max.	100	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	300	mW
Junction temperature	Tj	max.	150	oC
D.C. current gain $I_C = 10 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	<ul><li>3. 1. 2. 2. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.</li></ul>	40	
Transition frequency at $f = 100 \text{ MHz}$ $I_C = 40 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	fŢ	>	490	MHz
Voltage gain at f = 36 MHz (see Fig. 4) $I_C = 20 \text{ mA}$ ; $V_{CE} \approx 10.4 \text{ V}$	G <sub>V</sub>	typ.	24	dB
Interference voltage for $K = 1\%$ (see Fig. 3)	V <sub>(int)rms</sub>	typ.	120	mV

#### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm



MATINGS				
Limiting values in accordance with the Absolute Maximum System (	IEC 134)			
Collector-base voltage (open emitter)	$V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	VCEO	max.	15	V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	4,5	V
Collector current (d.c.)	IC	max.	100	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	300	mW
Storage temperature	$T_{stg}$	-55 to -	+150	oC
Junction temperature	Tj	max.	150	oC
THERMAL RESISTANCE				
From junction to tab	D	_	420	K/W
From junction to tab	R <sub>th j-t</sub>		430	N/ VV
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$	ІСВО	<	400	
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$ ; $T_j = 125 ^{\circ}\text{C}$	ГСВО	<	30	μΑ
Emitter cut-off current	1		100	A
$I_C = 0$ ; $V_{EB} = 2 V$	IEBO	<	100	nA
D.C. current gain IC = 10 mA; VCE = 1 V	hFE	>	40	
Transition frequency at f = 100 MHz				
$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$	fŢ	> '	500	MHz
$I_{C} = 40 \text{ mA}; V_{CE} = 10 \text{ V}$	fT	>	490	MHz
Collector capacitance at f = 1 MHz		typ.	2,2	пF
$I_E = I_e = 0$ ; $V_{CB} = 10 \text{ V}$	C <sub>C</sub>	<	3,5	•
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0; V_{EB} = 1 V$	Ce	$r < \frac{1}{2}$	4,5	pF
Feedback capacitance at f = 1 MHz	•	typ.	1,6	рF
$I_C = 0$ ; $V_{CE} = 10 \text{ V}$	C <sub>re</sub>	<	2,2	

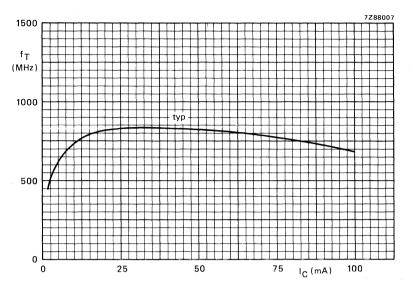
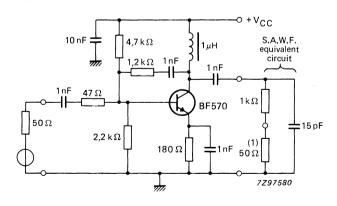


Fig. 2  $V_{CE} = 10 \text{ V}$ ;  $T_i = 25 \text{ }^{\circ}\text{C}$ .

#### APPLICATION INFORMATION



(1) Test instrument load.

Fig. 3 Large-signal handling i.f. preamplifier for surface acoustic wave filter.

### Performance

Supply voltage	Vcc	=	12 V
Collector current	lc	=	20 mA
Measuring frequency	fį	=	36 MHz
Input impedance	$z_i$	typ.	$50~\Omega//1~\mathrm{pF}$
Output impedance	$Z_{o}$	<	100 Ω
Voltage gain $G_{V} (in dB) = 20 \log \frac{V_{O}}{V_{i}}$	$G_{v}$	typ.	<b>24</b> dB
Interference voltage for K = 1%*	V(int)rms	typ.	120 mV

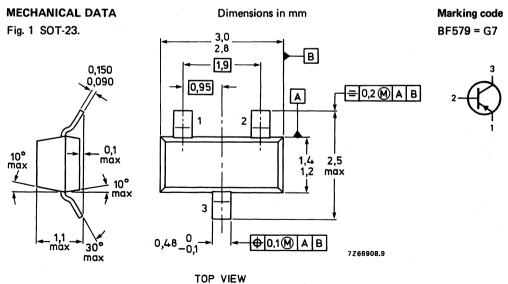
<sup>\*</sup> Input terminal voltage at 50  $\Omega$  internal resistance of signal generator, interference frequency 40 MHz, 80% modulated with 1 kHz.

# SILICON PLANAR TRANSISTOR

P-N-P transistor in a microminiature envelope primarily intended for u.h.f. applications in thick and thin-film circuits.

#### **QUICK REFERENCE DATA**

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	20 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	20 V
Collector current	-IC	max.	25 mA
Total power dissipation up to T <sub>amb</sub> = 85 °C	P <sub>tot</sub>	max.	150 mW
Junction temperature	Τį	max.	150 °C
Transition frequency at f = 100 MHz I <sub>E</sub> = 10 mA; -V <sub>CB</sub> = 10 V	fΤ	typ.	1350 MHz
Transducer gain (common base) $I_E = 10 \text{ mA}; -V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$ $R_S = 60 \Omega; R_L = 500 \Omega; T_{amb} = 25 \text{ °C}$	G <sub>tr</sub>	typ.	16 dB
Noise figure (common base) $I_E$ = 10 mA; $-V_{CB}$ = 10 V; f = 800 MHz $R_S$ = 60 $\Omega$ ; $R_L$ = 500 $\Omega$	F	typ.	4,5 dB



Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter) see Fig. 2 -V<sub>CBO</sub> 20 V max.

Collector-emitter voltage (open base) see Fig. 2 -VCEO max. 20 V

Emitter-base voltage (open collector) see Fig. 2 3 V  $-V_{FBO}$ max.

Collector current -Ic 25 mA max.

Base current (d.c.)  $-I_{R}$ 10 mA max. Total power dissipation up to Tamb = 85 °C\*\* P<sub>tot</sub> max. 150 mW

Storage temperature -65 to + 150 °C  $T_{sta}$ Junction temperature 150 °C  $T_i$ max.

### THERMAL CHARACTERISTICS\*

 $T_i = P \times (R_{th i-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

Thermal resistance From junction to tab R<sub>th i-t</sub>

280 K/W From tab to soldering points R<sub>th t-s</sub> 90 K/W From soldering points to ambient\*\* R<sub>th s-a</sub>

60 K/W

### **CHARACTERISTICS**

 $T_{amb} = 25 \, ^{\circ}C$ Collector cut-off current  $I_F = 0$ ;  $-V_{CB} = 15 V$ -ICBO < 100 nA

Emitter cut-off current

 $I_C = 0$ ;  $-V_{EB} = 1 V$ -lebo < 100 nA

D.C. current gain  $I_C = 10 \text{ mA}; -V_{CF} = 10 \text{ V}$ hFE > 20

Transition frequency at f = 100 MHz

 $I_F = 10 \text{ mA}; -V_{CB} = 10 \text{ V}$ fT typ. 1350 MHz Feedback capacitance at f = 500 kHz

 $I_E = 7 \text{ mA}; -V_{CB} = 10 \text{ V}$ 0,46 pF  $C_{re}$ typ.

 $I_F = 0$ ;  $-V_{CR} = 10 V$ 160 fF  $C_{rb}$ typ.

Transducer gain (common base)

 $I_E = 10 \text{ mA}; -V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$ 

 $G_{tr}$  $R_S = 60 \Omega$ ;  $R_1 = 500 \Omega$ 16 dB typ.

Noise figure (common base)  $I_E = 10 \text{ mA}; -V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$ 

 $R_S = 60 \Omega$ ;  $R_I = 500 \Omega$ F typ. 4,5 dB

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

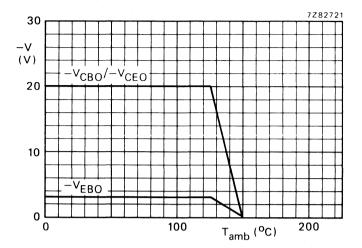


Fig. 2 Voltage derating curves.

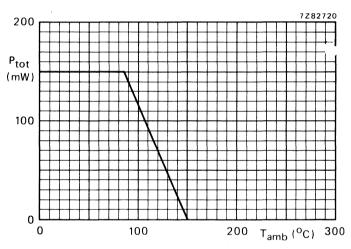


Fig. 3 Power derating curve.



# SILICON EPITAXIAL TRANSISTORS

### • For video output stages

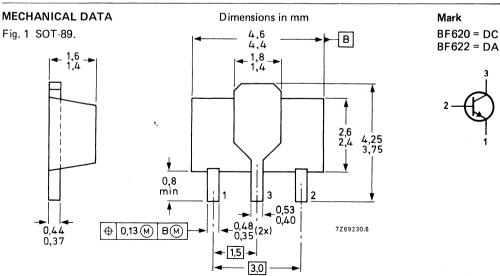
N-P-N transistors in a microminiature plastic envelope intended for class-B video output stages in colour television receivers.

P-N-P complements are BF621 and BF623 respectively.

#### QUICK REFERENCE DATA

See also Soldering recommendations.

			BF620	BF62	22
Collector-base voltage (open emitter)	$V_{CBO}$	max.	300	250	) V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	-	250	) V
Collector-emitter voltage (R <sub>BE</sub> = 2,7 k $\Omega$ )	$v_{CER}$	max.	300	-	V
Collector current (peak value)	<sup>I</sup> CM	max.	10	00	mA <sup>.</sup>
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.		1	W
Junction temperature	$T_{j}$	max.	15	50	oC
D.C. current gain $I_C = 25 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	hFE	>	. 5	50	
Transition frequency at $f = 35 \text{ MHz}$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	fT	>	6	80	MHz
Feedback capacitance at f = 1 MHz I <sub>C</sub> = 0; V <sub>CE</sub> = 30 V	C <sub>re</sub>	<	1,	,6	pF



BOTTOM VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BF620	BF6	22
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	300	250	) V
Collector-emitter voltage (open base)	V <sub>CEO</sub>	max.	- 1 -	250	) V
Collector-emitter voltage (R <sub>BE</sub> = 2,7 k $\Omega$ )	$V_{CER}$	max.	300	_	V
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.		5	V
Collector current (d.c.)	I <sub>C</sub>	max.	. !	50	mΑ
Collector current (peak value)	<sup>I</sup> CM	max.	10	00	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C mounted on a ceramic substrate area = 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	P.	max.		1	W
Storage temperature	P <sub>tot</sub>		-65 to + 1		oC
	⊤ <sub>stg</sub>			50	°C
Junction temperature	Tj	max.	1:	50	90
THERMAL RESISTANCE*					
From junction to collector tab	R <sub>th j-tab</sub>	, =	, ,	25	K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	R <sub>th j-a</sub>	=	1:	25	K/W
CHARACTERISTICS			BF620	BF6	200
T <sub>i</sub> = 25 °C unless otherwise specified			- D1 020	БГО	
Collector cut-off current I <sub>E</sub> = 0; V <sub>CB</sub> = 200 V	СВО	<	10	11	0 nA
Collector-emitter voltage					
$R_{BE} = 2.7 \text{ k}\Omega; V_{CE} = 250 \text{ V}$	CER	<	50		- nA
$R_{BE} = 2.7 \text{ k}\Omega; V_{CE} = 200 \text{ V}; T_j = 150 \text{ °C}$	ICER	<	10	10	0 μΑ
Saturation voltage $I_C = 30 \text{ mA}$ ; $I_B = 5 \text{ mA}$	V <sub>CE sat</sub>	<		),6	V
D.C. current gain $I_C = 25 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	hFE	>		50	
Transition frequency at $f = 35 \text{ MHz}$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	f <sub>T</sub>	>		60	MHz
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 0$ ; $V_{CE} = 30 \text{ V}$	C <sub>re</sub>	<	1	1,6	pF

<sup>\*</sup> See Thermal characteristics.

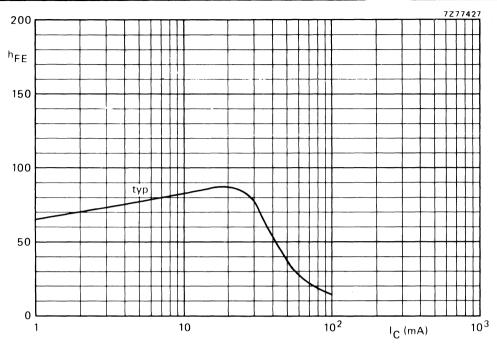


Fig. 2 Typical values at  $V_{CE} = 20 \text{ V}$ ;  $T_j = 25 \text{ }^{\circ}\text{C}$ .

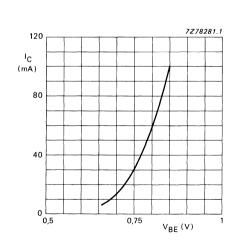


Fig. 3  $V_{CE} = 20 \text{ V}; T_j = 25 \text{ }^{\circ}\text{C}.$ 

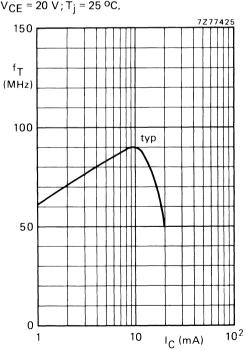


Fig. 4  $V_{CE} = 10 \text{ V}$ ;  $T_j = 25 \text{ }^{\circ}\text{C}$ ; f = 35 MHz.

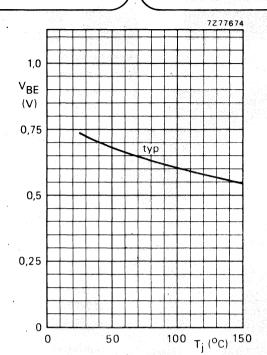


Fig. 5  $I_C = 25 \text{ mA}$ ;  $V_{CE} = 20 \text{ V}$ .

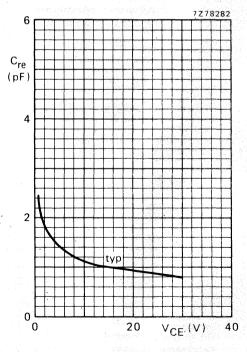


Fig. 7  $I_C = 0$ ; f = 1 MHz;  $T_j = 25 \text{ }^{\circ}\text{C}$ .

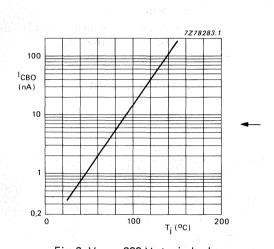


Fig. 6  $V_{CB}$  = 200 V; typical values.

# SILICON EPITAXIAL TRANSISTORS

#### • For video output stages

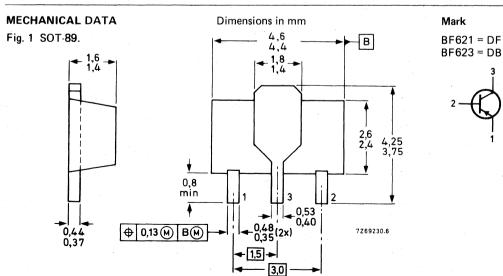
P-N-P transistors in a microminiature plastic envelope intended for application in class-B video output stages in colour television receivers.

N-P-N complements are BF620 and BF622 respectively.

### QUICK REFERENCE DATA

See also Soldering recommendations.

			BF621	BF623	_
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	300	250	٧
Collector-emitter voltage (open base)	$-V_{CEO}$	max.		250	V
Collector-emitter voltage ( $R_{BE} = 2.7 \text{ k}\Omega$ )	-V <sub>CER</sub>	max.	300		V
Collector current (peak value)	<sup>−1</sup> CM	max.	. 1	00	mΑ
Total power dissipation up to $T_{amb} = 25$ °C	$P_{tot}$	max.		1	W
Junction temperature	Тj	max.	1	50	oC
D.C. current gain $-I_C = 25 \text{ mA}; -V_{CE} = 20 \text{ V}$	hFE	>		50	
Transition frequency at $f = 35 \text{ MHz}$ -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 10 V	fŢ	>		60	MHz
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 0$ ; $-V_{CE} = 30 \text{ V}$	C <sub>re</sub>	<	•	1,6	pF



BOTTOM VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance with the Absolute Max	illiulli System (	ILC 134/				
			BF621	BF	623	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	300	.   .	250	V
Collector-emitter voltage (open base)	-VCEO	max.			250	V
Collector-emitter voltage ( $R_{BE} = 2.7 \text{ k}\Omega$ )	-V <sub>CER</sub>	max.	300	1		V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	1.	5		V
Collector current (d.c.)	-I <sub>C</sub>	max.		50		mA
Collector current (peak value)	-I <sub>CM</sub>	max.		100		mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C mounted on a ceramic substrate	n			•		<b>M</b> /
area = 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	P <sub>tot</sub>	max.	OF 4- 1	1		W
Storage temperature	T <sub>stg</sub>		-65 to +			oC
Junction temperature	т <sub>ј</sub>	max.		150		oC
THERMAL RESISTANCE*						
From junction to collector tab	R <sub>th j-tab</sub>	=		25		K/W
From junction to ambient in free air mounted on a ceramic substrate area = 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	R <sub>th j-a</sub>	=		125		K/W
anoknoso s <sub>i</sub> , min	rith j-a			120		10, 11
CHARACTERISTICS						
T <sub>j</sub> = 25 °C unless otherwise specified			DECO1	lar	000	
Collector cut-off current			BF621	BF	623	-
$I_E = 0; -V_{CB} = 200 \text{ V}$	-ICBO	<	10		10	nΑ
Collector-emitter voltage		_	<b>50</b>			
$R_{BE} = 2.7 \text{ k}\Omega; -V_{CE} = 250 \text{ V}$	-ICER	<	50	1	-	nA
$R_{BE} = 2.7 \text{ k}\Omega; -V_{CE} = 200 \text{ V}; T_j = 150 ^{\circ}\text{C}$	-ICER	<	10		10	μΑ
Saturation voltage $-I_C = 30 \text{ mA}$ ; $-I_B = 5 \text{ mA}$	-V <sub>CEsat</sub>	<		0,8		v
D.C. current gain -I <sub>C</sub> = 25 mA; -V <sub>CE</sub> = 20 V	hFE	>		50		
Transition frequency at $f = 35 \text{ MHz}$ $-I_C = 10 \text{ mA; } -V_{CE} = 10 \text{ V}$	$f_{T}$	>		60		MHz
Feedback capacitance at f = 1 MHz I <sub>C</sub> = 0; -V <sub>CE</sub> = 30 V	C <sub>re</sub>	<		1,6		pF

<sup>\*</sup> See Thermal characteristics.

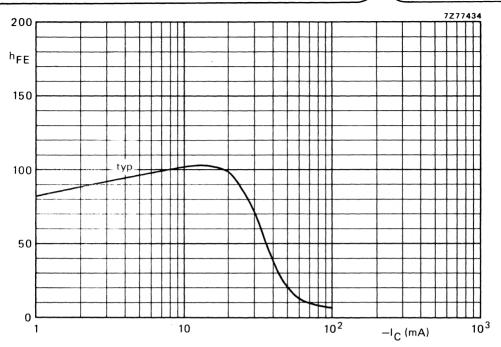


Fig. 2 Typical values at  $-V_{CE} = 20 \text{ V}$ ;  $T_j = 25 \text{ °C}$ .

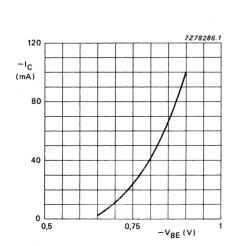


Fig. 3  $-V_{CE}$  = 20 V;  $T_j$  = 25  $^{\circ}C$ ; typical values.

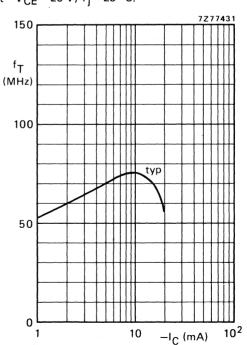
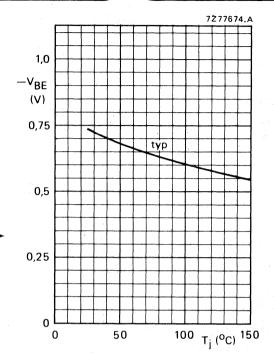


Fig. 4  $-V_{CE} = 10 \text{ V}$ ;  $T_j = 25 \text{ °C}$ ; f = 35 MHz.



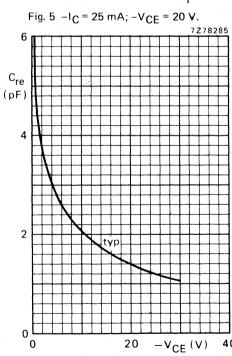


Fig. 7  $I_C = 0$ ; f = 1 MHz;  $T_j = 25$  °C.

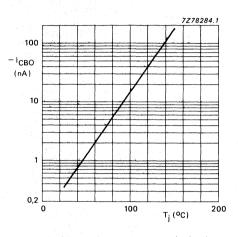


Fig. 6  $-V_{CB} = 200 \text{ V}$ ; typical values.

# SILICON PLANAR TRANSISTOR

P-N-P transistor, in a microminiature plastic envelope; intended for use as oscillator in v.h.f. tuners with extended frequency range and/or in conjunction with MOS-FETs in thick and thin-film circuits.

### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30 V
Collector current (peak value)	-ICM	max.	25 mA
Total power dissipation up to $T_{amb} = 60$ °C	P <sub>tot</sub>	max.	200 mW
Junction temperature	$T_{j}$	max.	150 °C
Transition frequency at f = 100 MHz			
$I_E = 5 \text{ mA}; -V_{CB} = 10 \text{ V}$	f <sub>T</sub>	typ.	650 MHz

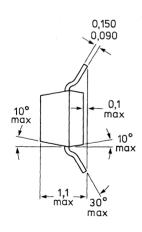
#### MECHANICAL DATA

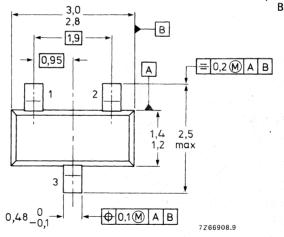
Fig. 1 SOT-23.

Dimensions in mm

Marking code







TOP VIEW

The state of the s						
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40	٧		
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30	٧		
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	4	V		
Collector current (peak value)	-I <sub>CM</sub>	max.	25	mΑ		
Base current (d.c.)	-I <sub>B</sub>	max.	10	mΑ		
Total power dissipation up to T <sub>amb</sub> = 60 °C **	P <sub>tot</sub>	max.	200	mW		
Storage temperature	T <sub>stg</sub>	-65 to +	150	oC		

 $\mathsf{T}_{\mathsf{i}}$ 

fΤ

### THERMAL CHARACTERISTICS\*

 $T_i = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

#### Thermal resistance

Junction temperature

From junction to tab	R <sub>th j-t</sub>	=	60 K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280 K/W
From soldering points to ambient**	$R_{ths-a}$	= "	90 K/W

#### **CHARACTERISTICS**

 $T_{amb} = 25 \text{ }^{\circ}\text{C}$ Collector cut-off current  $I_E = 0; -V_{CB} = 20 V$ 

-I<sub>CBO</sub> 50 nA D.C. current gain  $I_E = 3 \text{ mA}; -V_{CE} = 10 \text{ V}$ hFE 30

Transition frequency at f = 100 MHz  $I_E = 5 \text{ mA}; -V_{CB} = 10 \text{ V}$ 

Feedback capacitance at f = 1 MHz  $I_E = 1 \text{ mA}; -V_{CB} = 10 \text{ V}$ 

0,65 pF  $C_{re}$ typ.

typ.

max.

150 °C

650 MHz

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

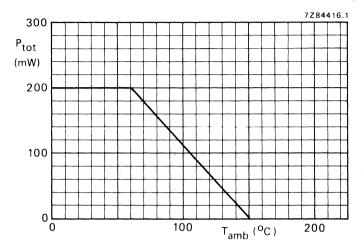


Fig. 2 Power derating curve.

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Marking code

BF767 = G9

# SILICON PLANAR TRANSISTOR

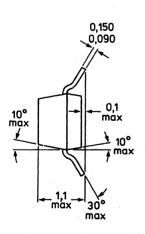
P-N-P transistor in a microminiature plastic envelope, primarily intended for application as gain controlled amplifier e.g. in v.h.f. and u.h.f. television tuners in thick and thin-film circuits.

### **QUICK REFERENCE DATA**

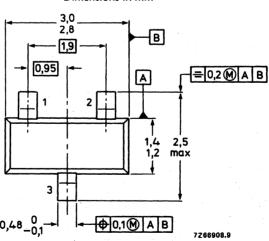
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	30	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30	V
Collector current (d.c.)	-IC	max.	20	mA
Total power dissipation up to T <sub>amb</sub> = 60 °C	P <sub>tot</sub>	max.	200	mW
Junction temperature	Ti	max.	150	оС
Transition frequency at f = 100 MHz IE = 3 mA; -VCB = 10 V	f <sub>T</sub>	typ.	900	MHz
Transducer gain (common base) $I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$ $R_S = 60 \Omega; R_1 = 500 \Omega$	G <sub>tr</sub>	typ.	13	dB
Noise figure (common base) $I_E = 3 \text{ mA;} -V_{CB} = 10 \text{ V;} \text{ f} = 800 \text{ MHz}$ $R_S = 60 \Omega; R_L = 500 \Omega$	F	typ.	4	dB

# MECHANICAL DATA

Fig. 1 SOT-23.



#### Dimensions in mm



TOP VIEW

RATINGS				
Limiting values in accordance with the Absolute Maximum System	(IEC 134)			
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	30	V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	3	V
Collector current (d.c.)	-I <sub>C</sub>	max.	20	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C **	P <sub>tot</sub>	max.	200	mW
Storage temperature	T <sub>stg</sub>	-65 to	+ 150	оС
Junction temperature	Тј	max.	150	оС
THERMAL CHARACTERISTICS*				
$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	=	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C; unless otherwise specified				
Collector cut-off current				
$I_E = 0; -V_{CB} = 15 V$	−lCBO	<	100	nA
D.C. current gain		>	15	
$-1_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}$	hFE	typ.	60	
$-I_E = 7 \text{ mA}; -V_{CB} = 4 \text{ V}$	hFE	>	10	
Transition frequency at f = 100 MHz				
$I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}$	fΤ	typ.	900	MHz
$I_E = 7 \text{ mA}; -V_{CB} = 5 \text{ V}$	fT	typ.	90	MHz
Feedback capacitance at f = 500 kHz	0	4	0.0	_
$I_E = 1 \text{ mA}; -V_{CB} = 10 \text{ V}$	C <sub>re</sub>	typ.	0,3	•
$I_E = 0$ ; $-V_{CB} = 10 \text{ V}$ Transducer gain (common base)	C <sub>rb</sub>	typ.	160	TF
$I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$				
$R_S = 60 \Omega$ ; $R_L = 500 \Omega$	$G_{tr}$	typ.	13	dB
Noise figure (common base)				
$I_E = 3 \text{ mA}; -V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$		<b>4</b> 1. e=	4	מג
$R_S = 60 \Omega$ ; $R_L = 500 \Omega$	F	typ.	4	dB

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

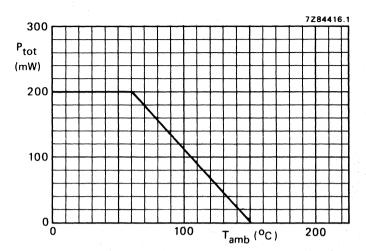


Fig. 2 Power derating curve.

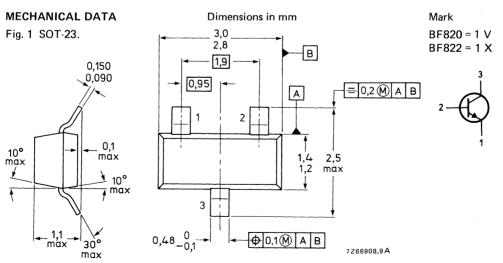


# SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic envelope intended for application in thick and thin-film circuits. Primarily intended for use in telephony and professional communication equipment. P-N-P components are BF821, BF823 respectively.

#### QUICK REFERENCE DATA

			BF820	BF822	
Collector-base voltage (open emitter)	$v_{CBO}$	max.	300	250	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	_	250	V
Collector-emitter voltage (R <sub>BE</sub> = 2,7 k $\Omega$ )	$v_{CER}$	max.	300	_	V
Collector current (peak value)	<sup>1</sup> CM	max.	1	100	mΑ
Total power dissipation up to T <sub>amb</sub> = 35 °C	$P_{tot}$	max.	3	310	mW
Junction temperature	Τj	max.	· 1	150	oC
D. C. current gain $I_C = 25 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	hFE	>		50	
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 0$ ; $V_{CE} = 30 \text{ V}$	C <sub>re</sub>	<		1,6	рF
Transition frequency at f = 35 MHz $I_C = 10 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	fT	>	•	60	MHz



TOP VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BF820	BF822
Collector-base voltage (open emitter)	$V_{CBO}$	max.	300	250 V
Collector-emitter voltage (open base)	$V_{CEO}$	max.		250 V
Collector-emitter voltage ( $R_{BE} = 2.7 \text{ k}\Omega$ )	VCER	max.	300	- V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	-	5 V
Collector current (d.c.)	IC	max.		50 mA
Collector current (peak value)	<sup>I</sup> CM	max.	•	100 mA
Total power dissipation*				
up to T <sub>amb</sub> = 35 °C	P <sub>tot</sub>	max.	, , , , , , , , , , , , , , , , , , ,	310 mW
Storage temperature	$T_{stq}$		<b>-65</b>	to + 150 °C
Junction temperature	Τį	max.		150 °C

### THERMAL CHARACTERISTICS\*\*

 $\mathsf{T}_j = \mathsf{P}(\mathsf{R}_{\mathsf{th}\;j\text{-}\mathsf{t}} + \mathsf{R}_{\mathsf{th}\;\mathsf{t}\text{-}\mathsf{s}} + \mathsf{R}_{\mathsf{th}\;\mathsf{s}\text{-}\mathsf{a}}) + \mathsf{T}_{\mathsf{amb}}$ 

Thermal resistance

from junction to tab from tab to soldering points from soldering points to ambient\*

$R_{th j-t} =$	50	K/W
$R_{th t-s} =$	260	K/W
$R_{th s-a} =$	60	K/W

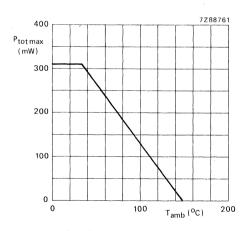


Fig. 2 Power derating curve.

<sup>\*</sup> Mounted on a ceramic substrate: area = 2,5 cm<sup>2</sup>; thickness = 0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

CHARACTERISTICS		В	F820	BF822	
T <sub>j</sub> = 25 °C unless otherwise specified					
Collector cut-off current I <sub>E</sub> = 0; V <sub>CB</sub> = 200 V	I <sub>CBO</sub>	<	10	10	) nA
Collector-emitter voltage					
$R_{BE}$ = 2,7 k $\Omega$ ; $V_{CE}$ = 250 V	ICER	<	50	50	nA
$R_{BE}$ = 2,7 k $\Omega$ ; $V_{CE}$ = 200 V; $T_j$ = 150 °C	<sup>I</sup> CER	<	10	10	μΑ
Saturation voltage				<del></del> -	
$I_C = 30 \text{ mA}; I_B = 5 \text{ mA}$	V <sub>CE</sub> sat	<	0	,6	V
D.C. current gain					
$I_C = 25 \text{ mA}; V_{CE} = 20 \text{ V}$	hFE	>	5	50	
Transition frequency at f = 35 MHz					
$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$	fT	>	6	60	MHz
Feedback capacitance at f = 1 MHz					
$I_C = 0$ ; $V_{CE} = 30 \text{ V}$	C <sub>re</sub>	<	1	,6	рF

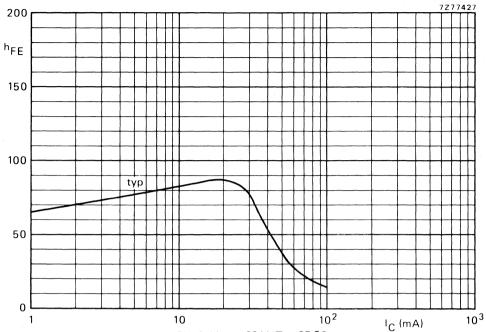


Fig. 3  $V_{CE} = 20 \text{ V}$ ;  $T_j = 25 \text{ °C}$ .

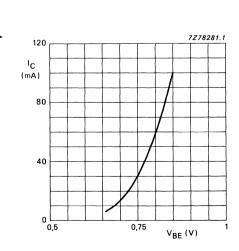


Fig. 4  $V_{CE}$  = 20 V;  $T_j$  = 25  $^{o}$ C; typical values.

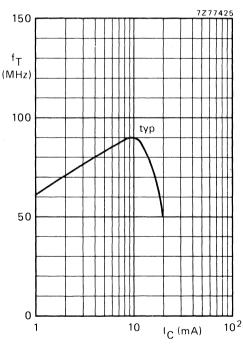


Fig. 5  $V_{CE}$  = 10 V;  $T_j$  = 25 °C, f = 35 MHz.

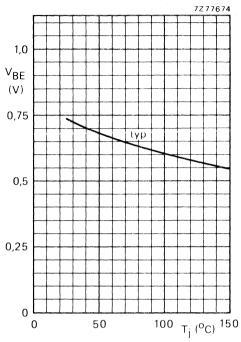


Fig. 6  $I_C = 25 \text{ mA}$ ;  $V_{CE} = 20 \text{ V}$ .

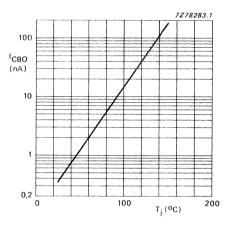


Fig. 7  $V_{CB} = 200 \text{ V}$ ; typical values.

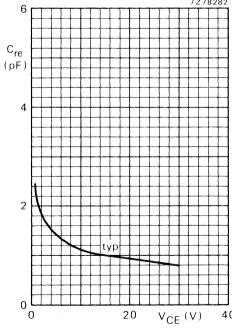


Fig. 8  $I_C = 0$ ; f = 1 MHz;  $T_j = 25 \text{ }^{\circ}\text{C}$ .

i i kaju - Kopaj kija bija i Sistem - Sali setelik, siste

Talka Majayen Salahi. Asalah salah Salahin Salahi

# SILICON EPITAXIAL TRANSISTORS

P-N-P transistors in a microminiature plastic envelope intended for application in thick and thin-film circuits. Primarily intended for use in telephony and professional communication equipment. N-P-N complements are BF820, BF822 respectively.

#### QUICK REFERENCE DATA

			BF821	BF823	_
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	300	250	_ V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	*****	250	V
Collector-emitter voltage (R <sub>BE</sub> = 2,7 k $\Omega$ )	-V <sub>CER</sub>	max.	300	_	٧
Collector current (peak value)	-I <sub>CM</sub>	max.	1	00	mΑ
Total power dissipation up to T <sub>amb</sub> = 35 °C	P <sub>tot</sub>	max.	3	10	mW
Junction temperature	Tį	max.	1	50	оС
D.C. current gain -I <sub>C</sub> = 25 mA; -V <sub>CE</sub> = 20 V	hFE	>		50	
Feedback capacitance at f = 1 MHzI <sub>C</sub> = 0;V <sub>CE</sub> = 30 V	C <sub>re</sub>	<		1,6	pF
Transition frequency at f = 35 MHz -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 10 V	f <sub>T</sub>	>		60	MHz

#### **MECHANICAL DATA** Dimensions in mm Mark 3,0 2,8 Fig. 1 SOT-23. BF821 = 1W BF823 = 1Y В 1,9 0,150 0.090 0,95 0.2 (M) A B A 2 0,1 10° max máx 2,5 max <u>₹</u> 10° ∡ max 3 \_1,1 \_max 30° 7Z66908.9A

TOP VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

		BF821 BF823
Collector-base voltage (open emitter)	−V <sub>CBO</sub> max	. 300 250 V
Collector-emitter voltage (open base)	V <sub>CEO</sub> max	. – 250 V
Collector-emitter voltage (R <sub>BE</sub> = 2,7 k $\Omega$ )	−V <sub>CER</sub> max	. 300 – V
Emitter-base voltage (open collector)	−V <sub>EBO</sub> max	5 V
Collector current (d.c.)	−I <sub>C</sub> max	. 50 mA
Collector current (peak value)	−I <sub>CM</sub> max	100 c 2 2 2 mA
Total power dissipation *		
up to T <sub>amb</sub> = 35 °C	P <sub>tot</sub> max	. 310 mW
Storage temperature	$T_{stg}$	-65 to +150 °C
Junction temperature	T <sub>j</sub> max	. 150 °C

#### THERMAL CHARACTERISTICS \*\*



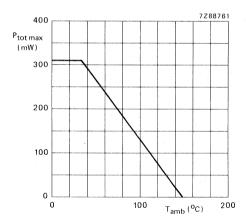


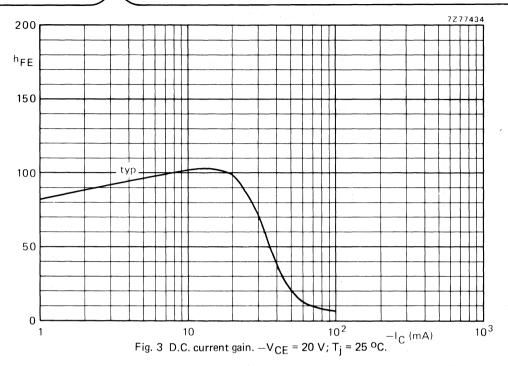
Fig. 2 Power derating curve.

<sup>\*</sup> Mounted on a ceramic substrate: area = 2,5 cm<sup>2</sup>; thickness = 0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

# CHARACTERISTICS

T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified		R	F821	BF823	
Collector cut-off current				D, 020	
$I_E = 0;V_{CB} = 200 V$	I <sub>CBO</sub>	<	10	10	) nA
Collector-emitter voltage				1	
$R_{BE} = 2.7 \text{ k}\Omega; -V_{CE} = 250 \text{ V}$	ICER	<	50	50	) nA
$R_{BE} = 2.7 \text{ k}\Omega; -V_{CE} = 200 \text{ V}; T_j = 150 \text{ °C}$	ICER	<	10	10	μΑ
Saturation voltage					•
$-I_C = 30 \text{ mA}$ ; $-I_B = 5 \text{ mA}$	V <sub>CEsat</sub>	<		0,8	V
D.C. current gain					
$-1_{C} = 25 \text{ mA}; -V_{CE} = 20 \text{ V}$	hFE	>		50	
Transition frequency at f = 35 MHz					
$-I_C = 10 \text{ mA}; -V_{CE} = 10 \text{ V}$	fΤ	>		60	MHz
Feedback capacitance at f = 1 MHz					
$I_C = 0$ ; $-V_{CF} = 30 \text{ V}$	$C_{re}$	<		1,6	рF



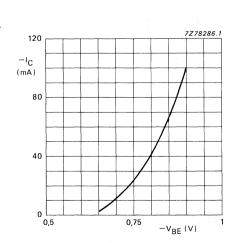


Fig. 4  $-V_{CE}$  = 20 V;  $T_i$  = 25 °C; typical values.

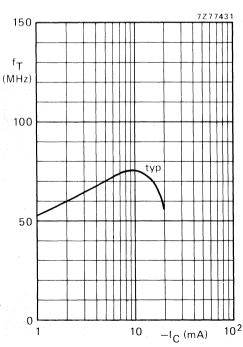


Fig. 5  $-V_{CE} = 10 \text{ V}$ ;  $T_j = 25 \text{ °C}$ ; f = 35 MHz.

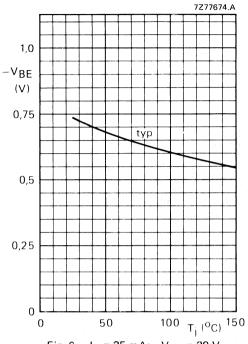


Fig. 6  $-I_C = 25 \text{ mA}; -V_{CE} = 20 \text{ V}.$ 

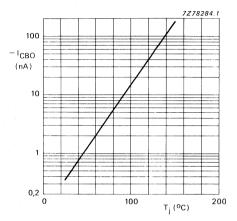


Fig. 7  $-V_{CB} = 200 \text{ V}$ ; typical values.

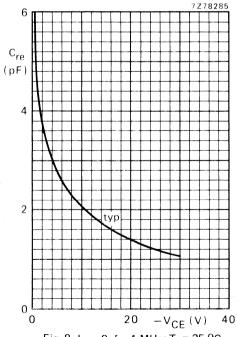


Fig. 8  $I_C = 0$ ; f = 1 MHz;  $T_j = 25 \text{ °C}$ .

# H.F. SILICON PLANAR EPITAXIAL TRANSISTOR

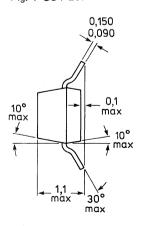
P-N-P transistor in a plastic SOT-23 envelope especially intended for r.f. stages in f.m. front-ends in common base configuration for SMD applications.

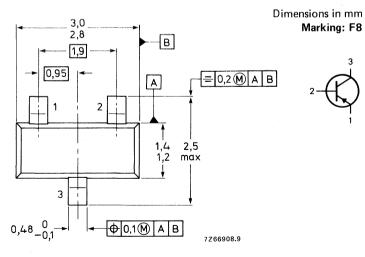
#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	30	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	٧
Collector current (d.c.)	-lc	max.	25	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	300	mW
Junction temperature	$T_{j}$	max.	150	oC
Base current $-I_C = 4 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$	IB	typ.	80 160	μΑ μΑ
Transition frequency $-I_C = 4 \text{ mA}; -V_{CE} = 10 \text{ V}$	fŢ	typ.	450	MHz
Noise figure at f = 100 MHz $-I_C = 2 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$ ; $G_S = 16.7 \text{ mS}$	F	typ.	3	dB
Feedback capacitance at $f = 1 \text{ MHz}$ $V_{EB} = 0$ ; $-V_{CB} = 10 \text{ V}$	C <sub>rb</sub>	typ.	0,1	pF

#### **MECHANICAL DATA**

Fig. 1 SOT-23.





Marking: F8

TOP VIEW

Limiting values in accordance with the Absolute Maximum System (IE	C 134)			
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	30	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	30	٧
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	4	٧
Collector current (d.c.)	-IC	max.	25	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	300	mW
Storage temperature	T <sub>stg</sub>	-55 to +	150	оС
Junction temperature	т <sub>ј</sub>	max.	150	оС
THERMAL RESISTANCE				
From junction to ambient in free air*	R <sub>th j-a</sub>	=	430	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Collector cut-off current I <sub>E</sub> = 0; -V <sub>CB</sub> = 30 V	-I <sub>CBO</sub>	<	50	nA
Emitter cut-off current I <sub>C</sub> = 0; -V <sub>EB</sub> = 4 V	-I <sub>EBO</sub>	<	10	μΑ
Base current $-I_C = 4 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$	−I <sub>B</sub>	typ.	80 160	μΑ μΑ
$-I_C = 1 \text{ mA}; -V_{CF} = 10 \text{ V}$	-I <sub>B</sub>	typ.		μΑ
Base-emitter voltage				
$-I_C = 4 \text{ mA}; -V_{CE} = 10 \text{ V}$	$-V_{BE}$	typ.	0,76	٧
Transition frequency at f = 100 MHz				
$-I_C = 1 \text{ mA}; -V_{CE} = 10 \text{ V}$	fŢ	typ.		MHz
$-I_C = 4 \text{ mA}; -V_{CE} = 10 \text{ V}$	fΤ	typ.		MHz
$-I_C = 8 \text{ mA}; -V_{CE} = 10 \text{ V}$	fΤ	typ.	440	MHz
Feedback capacitance at f = 1 MHz	<u></u>	+	0,1	nE.
V <sub>EB</sub> = 0; -V <sub>CB</sub> = 10 V Noise factor at f = 100 MHz	C <sub>rb</sub>	typ.	0,1	ρı
$-I_C = 2 \text{ mA}; -V_{CE} = 10 \text{ V};$				
G <sub>s</sub> = 16,7 mS	F	typ.	3	dB
$-I_C = 5 \text{ mA}; -V_{CE} = 10 \text{ V};$				
$G_s = 6.7 \text{ mS}; -jB_s = 5 \text{ mS}$	F	typ.	3,5	dB

<sup>\*</sup> Mounted on ceramic substrate of 8 mm x 10 mm x 0,7 mm.

y-parameters (common base) at f = 100 MHz  $-I_C = 4 \text{ mA}; -V_{CB} = 10 \text{ V}$ 125 mS Input conductance typ. gib 64 pF Input capacitance  $C_{ib}$ typ. 100 mS Transfer admittance 19<sub>fb</sub> typ. Phase angle of transfer admittance 1470 typ.  $\varphi_{\mathsf{fb}}$ Output conductance 40 μS  $g_{ob}$ typ. Output capacitance  $C_{ob}$ typ. 1,25 pF 220 μS Feedback admittance |y<sub>rb</sub>| typ. 85° Phase angle of feedback admittance typ.  $\varphi_{\mathsf{rb}}$ 

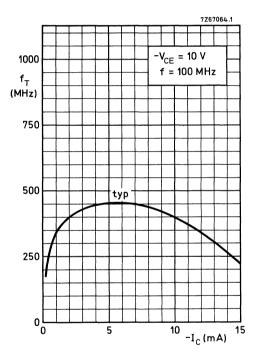


Fig. 2.

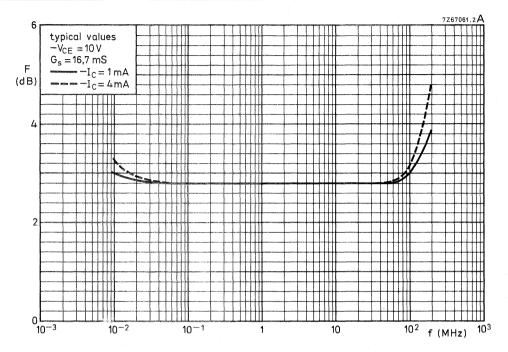


Fig. 3.

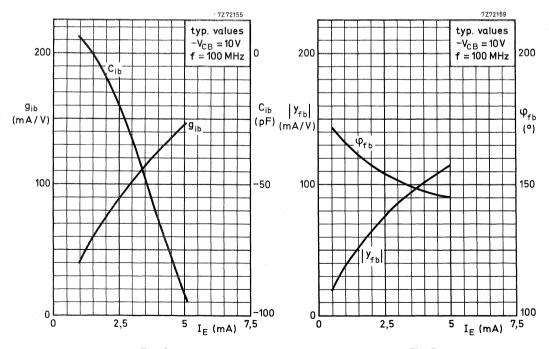
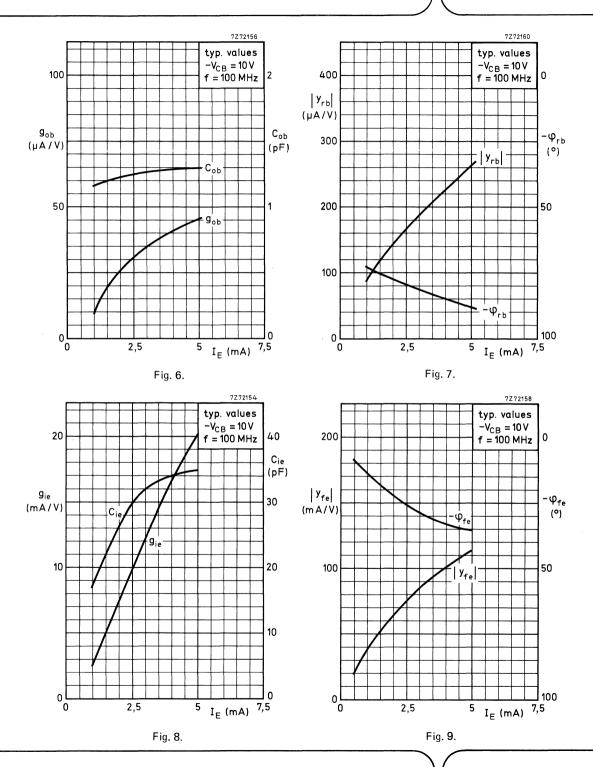


Fig. 4.

Fig. 5.



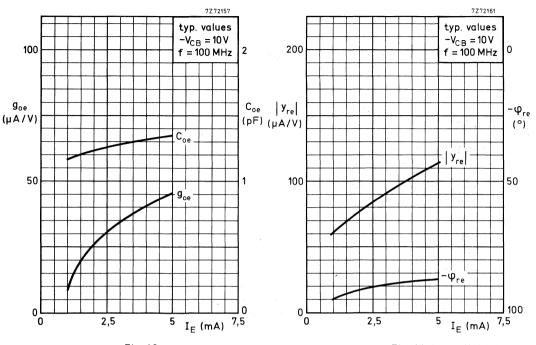


Fig. 11.

# SILICON PLANAR TRANSISTORS

N-P-N transistors in a plastic SOT-23 envelope.

Primarily intended for a.m. mixers and i.f. amplifiers in a.m./f.m. receivers using SMD technology.

#### **QUICK REFERENCE DATA**

		BF840   BF841		
Collector-base voltage (open emitter)	$V_{CBO}$	max.	40	V
Collector-emitter voltage (open base)	VCEO	max.	40	V
Collector current (d.c.)	IC	max.	25	mΑ
Base current I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 10 V	ΙΒ	4,5-	-15   82	28 μΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	300	mW
Junction temperature	Τj	max.	150	oC
Feedback capacitance at f = 1 MHz I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 10 V	C <sub>re</sub>	typ.	0,3	pF

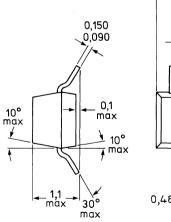
#### **MECHANICAL DATA**

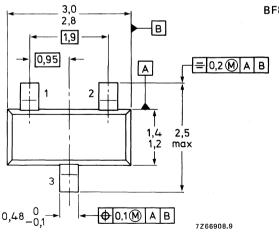
Fig. 1 SOT-23.

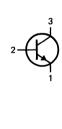
Dimensions in mm

Marking code:

BF840 : F3 BF841 : F31







TOP VIEW

	RATINGS					
	Limiting values in accordance with the Absolute Maximum System	n (IEC 134	4)			
	Collector-base voltage (open emitter)	VCBO		max.	40	٧
•	Collector-emitter voltage (open base)	VCEO		max.	40	V
	Emitter-base voltage (open collector)	VEBO		max.	4	٧
	Collector current (d.c.)	lc		max.	25	mA ·
	Total power dissipation up to T <sub>amb</sub> = 25 °C*	$P_{tot}$		max.	300	mW
	Storage temperature	$T_{stg}$		55	to +150	oC
	Junction temperature	$T_{j}$		max.	150	oC
	THERMAL RESISTANCE					
	From junction to ambient*	R <sub>th j-a</sub>		=	430	K/W
	CHARACTERISTICS					
	T <sub>j</sub> = 25 °C unless otherwise specified					
	Collector cut-off current  IE = 0; VCB = 20 V	ICBO		max.	100	nA
	Base-emitter voltage	050			700	\ /
	$I_C = 1 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	VBE		typ. 650	700 to 740	
			E	3F840	BF841	
	Base current					_
	$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	ΙΒ	4	,5–15	8–28	μΑ
	Transition frequency at f = 100 MHz I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 10 V	fT	typ.	380	380	MHz
	Feedback capacitance at f = 1 MHz I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 10 V	C <sub>re</sub>	typ.	0,3	0,3	pF
	Noise figure					

2,0 dB

 $I_{C}$  = 1 mA;  $V_{CE}$  = 10 V; f = 0,2 MHz;  $R_{S}$  = 200  $\Omega$ 

<sup>\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Depletion type field-effect transistor in a plastic SOT-143 microminiature envelope with source and substrate interconnected. This MOS-FET tetrode is intended for use in u.h.f. applications in television tuners. The device is also suitable for use in professional communication equipment.

The device is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

#### **QUICK REFERENCE DATA**

Drain-source voltage	$V_{DS}$	max.	20 V
Drain current (peak value)	IDM	max.	30 mA
Total power dissipation up to $T_{amb} = 60  {}^{\circ}C$	$P_{tot}$	max.	200 mW
Junction temperature	$T_{j}$	max.	150 °C
Transfer admittance at f = 1 kHz			
$I_D = 7 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; + $V_{G2-S} = 4 \text{ V}$	Yfs	typ.	12 mS
Feedback capacitance at f = 1 MHz			
$I_D = 7 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	$C_{rs}$	typ.	25 fF
Noise figure at G <sub>S</sub> = 2 mS			
$I_D = 7 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$ ; $f = 800 \text{ MHz}$	F	typ.	2,8 dB

#### **MECHANICAL DATA** Dimensions in mm Marking code BF989 = M89Fig. 1 SOT-143. 3,0 2,8 0.150 В 0.090 1,9 (2) $= 0.2 \, \text{(M)} \, \text{A} \, \text{B}$ Α 3 (3) 92 (4)910,1 10° max 2.5 max 1.2 max 10° ₹ max 2 (1) 1,1 max **⊕** 0,1 M A B 3Ò° 0,48 0 0,88 - 0.1 max 7285014.7

TOP VIEW

RATINGS				
Limiting values in accordance with the Absolute Maximum	System (IEC 134)			
Drain-source voltage	V <sub>DS</sub>	max.	20	V
Drain current (d.c. or average)	ID	max.	20	mA
Drain current (peak value)	IDM	max.	30	mΑ
Gate 1 - source current	± IG1-S	max.	10	mA
Gate 2 - source current	± IG2-S	max.	10	mA
Total power dissipation up to T <sub>amb</sub> = 60 °C*	P <sub>tot</sub>	max.	200	mW
Storage temperature	T <sub>stg</sub>	-65 to +	150	οС
Junction temperature	Tj	max.	150	_
THERMAL RESISTANCE		20 <b>.64</b> 931		
From junction to ambient in free air*	R <sub>th j-a</sub>	= 908740	460	K/W
STATIC CHARACTERISTICS			i and	
T <sub>amb</sub> = 25 °C unless otherwise specified				
Gate cut-off currents				
$^{\pm}$ V <sub>G1-S</sub> = 5 V; V <sub>G2-S</sub> = V <sub>DS</sub> = 0 $^{\pm}$ V <sub>G2-S</sub> = 5 V; V <sub>G1-S</sub> = V <sub>DS</sub> = 0	<sup>±</sup> <sup>I</sup> G1-SS <sup>±</sup> <sup>I</sup> G2-SS	< <		nA nA
Drain current $V_{DS} = 10 \text{ V}; V_{G1-S} = 0; + V_{G2-S} = 4 \text{ V}; T_i = 25 \text{ °C}$	I <sub>DSS</sub>	2 t	o <b>20</b>	mA
Gate-source breakdown voltages	<i>D</i> 33			
$^{\pm}$ I <sub>G1-SS</sub> = 10 mA; V <sub>G2-S</sub> = V <sub>DS</sub> = 0 $^{\pm}$ I <sub>G2-SS</sub> = 10 mA; V <sub>G1-S</sub> = V <sub>DS</sub> = 0	<sup>± V</sup> (BR)G1-SS <sup>± V</sup> (BR)G2-SS		o 20 o 20	
Gate-source cut-off voltages				
$I_D = 20 \mu A$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$ $I_D = 20 \mu A$ ; $V_{DS} = 10 \text{ V}$ ; $V_{G1-S} = 0$	<sup>−V</sup> (P)G1-S −V(P)G2-S	<	2,7 2,7	
DYNAMIC CHARACTERISTICS				
Measuring conditions (common source): I <sub>D</sub> = 7 mA; V <sub>DS</sub> =	10 V; + V <sub>G2-S</sub> = 4	V; T <sub>amb</sub> =	= 25	оС
Transfer admittance at f = 1 kHz	Yfs	> typ.		mS mS
Input capacitance at gate 1; f = 1 MHz	C <sub>ig1-s</sub>	typ.	1,8	pF
Input capacitance at gate 2; f = 1 MHz	C <sub>ig2-s</sub>	typ.	1,0	pF
Feedback capacitance at f = 1 MHz	C <sub>rs</sub>	typ.		fF
Output capacitance at f = 1 MHz	Cos	typ.	0,9	pF
Noise figure at G <sub>S</sub> = 2 mS f = 200 MHz	F	41/15	1.6	٩D
f - 200 MU-	F	typ.	0,1	dB

1,6 dB 2,8 dB

typ.

f = 800 MHz

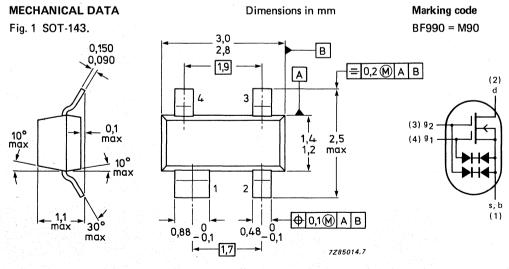
<sup>\*</sup> Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Depletion type field-effect transistor in a plastic microminiature envelope with source and substrate interconnected, intended for u.h.f. applications, such as u.h.f. television tuners and professional communication equipment.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

#### **QUICK REFERENCE DATA**

Drain-source voltage	$v_{ m DS}$	max.	18	٧
Drain current (average)	<sup>1</sup> D(AV)	max.	30	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.	200	mW
Junction temperature	$T_{j}$	max.	150	οС
Transfer admittance at $f = 1 \text{ kHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	y <sub>fs</sub>	typ.	19	mS
Feedback capacitance at $f = 1 \text{ MHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	C <sub>rs</sub>	typ.	25	fF
Noise figure at optimum source admittance $I_D = 10 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$ ; $f = 800 \text{ MHz}$	F	typ.	2,8	dB



TOP VIEW

Drain-source voltage	V <sub>DS</sub>	max.	18 V
Drain current (average)	ID(AV)	max.	30 mA
Gate 1-source current	± IG1-S	max.	10 mA
Gate 2-source current	± 1G2-S	max.	10 mA

Limiting values in accordance with the Absolute Maximum System (IEC 134)

± IG2-S Total power dissipation up to T<sub>amb</sub> = 60 °C\*  $P_{tot}$ max. 200 mW  $T_{stg}$ Storage temperature -65 to + 150 °C

 $T_i$ 150 °C Junction temperature max.

#### THERMAL RESISTANCE

From junction to ambient in free air\* 460 K/W R<sub>th j-a</sub>

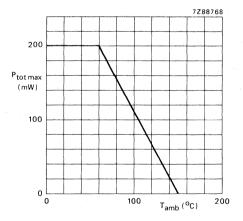


Fig. 2 Power derating curve.

<sup>\*</sup> Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

#### STATIC CHARACTERISTICS

Tamb = 25 °C unless otherwise specified

Gate cut-off currents

$$\pm V_{G1-S} = 7 \text{ V}; V_{G2-S} = V_{DS} = 0$$
  $\pm I_{G1-SS}$  < 25 nA

gate 2:

$$\pm V_{G2-S} = 7 \text{ V; } V_{G1-S} = V_{DS} = 0$$
  $\pm I_{G2-SS}$  < 25 nA

Gate-source breakdown voltages

± V(BR)G1-SS

gate 2:

$$\pm I_{G2-SS} = 10 \text{ mA}; V_{G1-S} = V_{DS} = 0$$

<

typ.

<

8 V .

Gate-source cut-off voltages gate 1;

$$I_D = 20 \mu A$$
;  $V_{DS} = 10 V$ ;  $+ V_{G2-S} = 4 V$ 

$$I_D = 20 \mu A$$
;  $V_{DS} = 10 V$ ;  $V_{G1-S} = 0$ 

#### **DYNAMIC CHARACTERISTICS**

Measuring conditions (common source): ID = 10 mA; VDS = 10 V; + VG2.S = 4 V; Tamb = 25 °C

Transfer admittance at f = 1 kHz

Input capacitance at gate 
$$2$$
;  $f = 1 \text{ MHz}$ 

Noise figure at 
$$f = 800 \text{ MHz}$$
;  $G_S = 5 \text{ mS}$ 

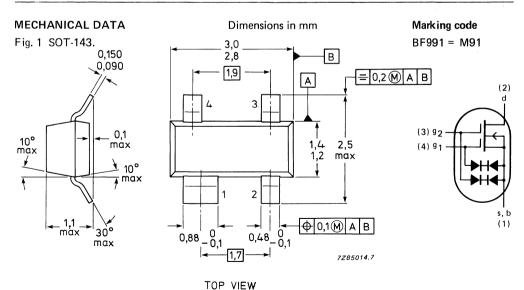


Depletion type field-effect transistor in a plastic SOT-143 microminiature envelope with source and substrate interconnected. This MOS-FET tetrode is intended for use in v.h.f. applications, such as v.h.f. television tuners and f.m. tuners. The device is also suitable for use in professional communication equipment.

The device is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

#### **QUICK REFERENCE DATA**

Drain-source voltage	V <sub>DS</sub>	max.	20 V
Drain current	۱ <sub>D</sub>	max.	20 mA
Total power dissipation up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.	200 mW
Junction temperature	$T_{j}$	max.	150 °C
Transfer admittance at $f = 1 \text{ kHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	Yfs	typ.	14 mS
Feedback capacitance at f = 1 MHz $I_D = 10 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	C <sub>rs</sub>	typ.	20 fF
Noise figure at optimum source admittance $I_D = 10 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$ ; $f = 200 \text{ MHz}$	F	typ.	0,7 dB



Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$V_{DS}$	max.	20	V
Drain current (d.c. or average)	ID	max.	20	mΑ
Drain current (peak value)	I <sub>DM</sub>	max.	30	mΑ
Gate 1 - source current	<sup>± I</sup> G1-S	max.	10	mΑ
Gate 2 - source current	± I <sub>G2-S</sub>	max.	10	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C*	P <sub>tot</sub>	max.	200	mW
Storage temperature	T <sub>stg</sub>	-65 to +	150	oC
Junction temperature	Tj	max.	150	oC
THERMAL RESISTANCE				
From junction to ambient in free air*	R <sub>th j-a</sub>	=	460	K/W
STATIC CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Gate cut-off currents				
$\pm V_{G1-S} = 5 V; V_{G2-S} = V_{DS} = 0$	<sup>± I</sup> G1-SS	<		nΑ
$\pm V_{G2-S} = 5 V; V_{G1-S} = V_{DS} = 0$	± IG2-SS	<	50	nΑ
Drain current				

 $V_{DS} = 10 \text{ V}; V_{G1-S} = 0; + V_{G2-S} = 4 \text{ V}; T_i = 25 \text{ }^{\circ}\text{C}$ 4 to 25 mA <sup>I</sup>DSS Gate-source breakdown voltages 6 V  $\pm I_{G1-SS} = 10 \text{ mA}; V_{G2-S} = V_{DS} = 0$ <sup>±</sup> V(BR)G1-SS  $\pm I_{G2-SS} = 10 \text{ mA}; V_{G1-S} = V_{DS} = 0$ ± V(BR)G2-SS 6 V Gate-source cut-off voltages  $I_D = 20 \mu A$ ;  $V_{DS} = 10 V$ ;  $+ V_{G2-S} = 4 V$ −V(P)G1-S −V(P)G2-S 2,5 V

2,5 V

#### **DYNAMIC CHARACTERISTICS**

 $I_D = 20 \mu A$ ;  $V_{DS} = 10 \text{ V}$ ;  $V_{G1-S} = 0$ 

Measuring conditions (common source):  $I_D = 10 \text{ mA}$ ;  $V_{DS} = 10 \text{ V}$ ;  $+ V_{G2-S} = 4 \text{ V}$ ;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ 

Transfer admittance at f = 1 kHz	Yfs	typ.	14 mS
Input capacitance at gate 1; f = 1 MHz	C <sub>ig1-s</sub>	typ.	2,1 pF
Input capacitance at gate 2; f = 1 MHz	C <sub>ig2-s</sub>	typ.	1,0 pF
Feedback capacitance at f = 1 MHz	$C_{rs}$	typ.	20 fF
Output capacitance at f = 1 MHz	$C_{os}$	typ.	1,1 pF
Noise figure $f = 100 \text{ MHz}$ ; $G_S = 1 \text{ mS}$	F	typ.	0,7 dB 1,7 dB
f = 200 MHz; G <sub>S</sub> = 2 mS	F	typ.	1,0 dB 2,0 dB
Transducer gain ** $f = 100 \text{ MHz}$ ; $G_S = 1 \text{ mS}$ ; $G_L = 0.5 \text{ mS}$ $f = 200 \text{ MHz}$ ; $G_S = 2 \text{ mS}$ ; $G_L = 0.5 \text{ mS}$	G <sub>tr</sub> G <sub>tr</sub>	typ. typ.	29 dB 26 dB

Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

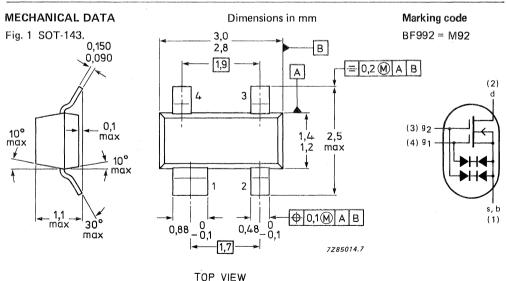
Crystal mounted in a SOT-103 envelope.

Depletion type field-effect transistor in a plastic SOT-143 microminiature envelope with source and substrate interconnected. This MOS-FET tetrode is intended for use in v.h.f. applications, such as v.h.f. television tuners, FM tuners with a 12 volt supply voltage. The device is also suitable for use in professional communication equipment.

The device is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

#### QUICK REFERENCE DATA

Drain-source voltage	$v_{DS}$	max.	20 V
Drain current	ID	max.	40 mA
Total power dissipation up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.	200 mW
Junction temperature	$T_{j}$	max.	150 °C
Transfer admittance at f = 1 kHz $I_D = 15$ mA; $V_{DS} = 10$ V; + $V_{G2-S} = 4$ V	Yfs	typ.	25 mS
Feedback capacitance at f = 1 MHz $I_D$ = 15 mA; $V_{DS}$ = 10 V; + $V_{G2-S}$ = 4 V	C <sub>rs</sub>	typ.	30 fF
Noise figure at $G_S$ = 2 mS $I_D$ = 15 mA; $V_{DS}$ = 10 V; + $V_{G2-S}$ = 4 V; f = 200 MHz	F	typ.	1,2 dB



Limiting values in accordance with the Absolute Maximum System (IEC 134)

	,,000111 (120 101)			
Drain-source voltage	V <sub>DS</sub>	max.	20	V
Drain current (d.c. or average)	ID	max.	40	mΑ
Gate 1 - source current	± IG1-S	max.	10	mΑ
Gate 2 - source current	± IG2-S	max.	10	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C*	P <sub>tot</sub>	max.	200	mW
Storage temperature	T <sub>stg</sub>	-65 to +	150	оС
Junction temperature	Ti	max.	150	оС
THERMAL RESISTANCE				
From junction to ambient in free air*	R <sub>th j-a</sub>	= -	460	K/W
STATIC CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Gate cut-off currents				
± V <sub>G1-S</sub> = 7 V; V <sub>G2-S</sub> = V <sub>DS</sub> = 0 ± V <sub>G2-S</sub> = 7 V; V <sub>G1-S</sub> = V <sub>DS</sub> = 0	<sup>± I</sup> G1-SS <sup>± I</sup> G2-SS	< .		nA nA
Gate-source breakdown voltages	- 162-55		20	, .
$\pm I_{G1-SS} = 10 \text{ mA}; V_{G2-S} = V_{DS} = 0$	± V(BR)G1-SS	> >	_	٧
$\pm I_{G2-SS} = 10 \text{ mA}; V_{G1-S} = V_{DS} = 0$	<sup>± V</sup> (BR)G2-SS	>	8	V
Gate-source cut-off voltages $I_D = 20 \mu A; V_{DS} = 10 V; + V_{G2-S} = 4 V$ $I_D = 20 \mu A; V_{DS} = 10 V; V_{G1-S} = 0$	-V(P)G1-S -V(P)G2-S	0,2 to 0,2 to		
DYNAMIC CHARACTERISTICS				

ineasoring conditions (common source): 1D - 15 m.	A, VDS - 10 V, + VG2.	.S = 4 v , I am	1b - 25 °C
Transfer admittance at f = 1 kHz	y <sub>fs</sub>	> typ.	20 mS 25 mS
Input capacitance at gate 1; f = 1 MHz	C <sub>ig1-s</sub>	typ.	4 pF
Input capacitance at gate 2; f = 1 MHz	C <sub>ig2-s</sub>	typ.	1,7 pF
Feedback capacitance at f = 1 MHz	C <sub>rs</sub>	typ.	30 fF 40 fF
Output capacitance at f = 1 MHz	Cos	typ.	2 pF
Noise figure at $f = 200 \text{ MHz}$ ; $G_S = 2 \text{ mS}$	* , <b>F</b>	typ.	1,2 dB

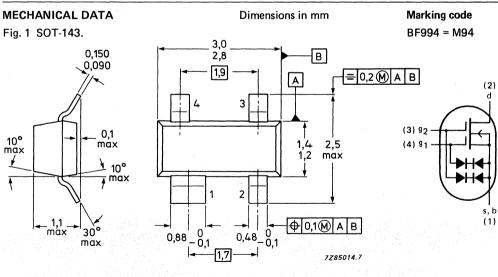
<sup>\*</sup> Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Depletion type field-effect transistor in a plastic microminiature envelope with source and substrate interconnected, intended for u.h.f. and v.h.f. applications, such as u.h.f./v.h.f. television tuners and professional communication equipment.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

#### **QUICK REFERENCE DATA**

Drain-source voltage	V <sub>DS</sub>	max.	20 V
Drain current (average)	I <sub>D(AV)</sub>	max.	30 mA
Total power dissipation up to T <sub>amb</sub> = 60 °C	P <sub>tot</sub>	max.	200 mW
Junction temperature	Tj	max.	150 °C
Transfer admittance at $f = 1 \text{ kHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	y <sub>fs</sub>	typ.	17 mS
Feedback capacitance at $f = 1 \text{ MHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	C <sub>rs</sub>	typ.	25 fF
Noise figure at optimum source admittance $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$ ; $f = 200 \text{ MHz}$	F	typ.	1,5 dB



TOP VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

•			
Drain-source voltage	$v_{DS}$	max.	20 V
Drain current (average)	ID(AV)	max.	30 mA
Gate 1-source current	± IG1-S	max.	10 mA
Gate 2-source current	± I <sub>G2-S</sub>	max.	10 mA
Total power dissipation up to T <sub>amb</sub> = 60 °C*	$P_{tot}$	max.	200 mW
Storage temperature	$T_{stg}$	-65 to +	150 °C
Junction temperature	$oldsymbol{T}_{oldsymbol{J}}$	max.	150 °C
THE DATA L. DECOUT A RICE			

#### THERMAL RESISTANCE

From junction to ambient in free air\*  $R_{th j-a} = 460 \text{ K/W}$ 

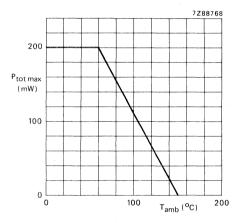


Fig. 2 Power derating curve.

<sup>\*</sup> Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,6 mm.

#### STATIC CHARACTERISTICS

Tamb = 25 °C unless otherwise specified

Gate cut-off currents

$$\pm V_{G1-S} = 5 \text{ V; } V_{G2-S} = V_{DS} = 0$$
  $\pm I_{G1-SS}$  < 50 nA

$$\pm V_{G2-S} = 5 V; V_{G1-S} = V_{DS} = 0$$
  $\pm I_{G2-SS}$  < 50 nA

Gate-source breakdown voltages

$$\pm$$
 I  $_{G1\text{-SS}}$  = 10 mA; V  $_{G2\text{-S}}$  = V  $_{DS}$  = 0

6 to 20 V

gate 2;

$$\pm I_{G2-SS} = 10 \text{ mA}; V_{G1-S} = V_{DS} = 0$$

6 to 20 V

Gate-source cut-off voltages

$$I_D = 20 \,\mu\text{A}$$
;  $V_{DS} = 15 \,\text{V}$ ; +  $V_{G2-S} = 4 \,\text{V}$ 

$$I_D = 20 \mu A$$
;  $V_{DS} = 15 \text{ V}$ ;  $V_{G1-S} = 0$   
Drain-source cut-off voltage

<

 $V_{DS} = 15 \text{ V}; V_{G2-S} = 4 \text{ V}$ 

#### **DYNAMIC CHARACTERISTCS**

Transfer admittance at f = 1 kHz	y <sub>fs</sub>	> typ.	15 mS 17 mS
Input capacitance at gate 1; f = 1 MHz	C <sub>iq1-s</sub>	typ.	2,5 pF
Input capacitance at gate 2; f = 1 MHz	C <sub>iq2-s</sub>	typ.	1,2 pF
Feedback capacitance at f = 1 MHz	C <sub>rs</sub>	typ.	25 fF
Output capacitance at f = 1 MHz	$C_{os}$	typ.	1,0 pF
Noise figure at f = 200 MHz; G <sub>S</sub> = 2 mS	F	typ.	1,5 dB

Power gain at  $G_S = 2 \text{ mS}$ 

$$G_p$$

2.8 dB



Depletion type field-effect transistor in a plastic microminiature envelope (SOT-143) with source and substrate interconnected and intended for v.h.f. applications in television tuners, using SMD\* technology. The device is also suitable for use in professional communication equipment.

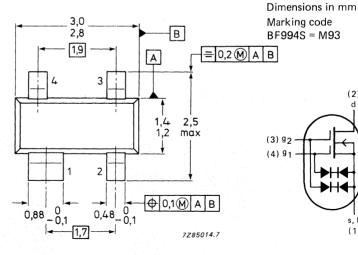
This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

## QUICK REFERENCE DATA

Drain-source voltage	V <sub>DS</sub>	max.	20 V
Drain current	ID	max.	50 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	300 mW
Junction temperature	$T_{j}$	max.	150 °C
Transfer admittance at $f = 1 \text{ kHz}$ ID = 10  mA; $VDS = 15  V$ ; $+VG2-S = 4  V$	y <sub>fs</sub>	typ.	18 mS
Feedback capacitance at $f = 1 \text{ MHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+V_{G2-S} = 4 \text{ V}$	C <sub>rs</sub>	typ.	25 fF
Noise figure at $G_S$ = 2 mS $I_D$ = 10 mA; $V_{DS}$ = 15 V; $+V_{G2-S}$ = 4 V; $f$ = 200 MHz	F	typ.	1,0 dB

#### **MECHANICAL DATA**

Fig. 1 SOT-143. 0,150 0,090 0,1 max 10° max <u>≯</u> 10° → max \_1,1 \_ max 3ò° max



TOP VIEW

s, b (1)

(2)

<sup>\*</sup> Surface Mounted Devices.

RATINGS				
Limiting values in accordance with the Absolute Maximum System	n (IEC 134)			
Drain-source voltage	V <sub>DS</sub>	max.	20	٧
Drain current (d.c. or average)	ID	max.	50	mΑ
Gate 1 - source current	±IG1-S	max.	10	mΑ
Gate 2 - source current	±IG2-S	max.	10	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	300	mW
Storage temperature	$T_{stg}$	-65 to	150	oC
Junction temperature	$T_{j}$	max.	150	oC
THERMAL RESISTANCE				
From junction to ambient in free air mounted on a ceramic substrate of 8 mm $\times$ 10 mm $\times$ 0,7 mm	R <sub>th j-a</sub>	20 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	430	K/W
STATIC CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Gate cut-off currents				
$\pm V_{G1-S} = 5 \text{ V}; V_{G2-S} = V_{DS} = 0$ $\pm V_{G2-S} = 5 \text{ V}; V_{G1-S} = V_{DS} = 0$	±IG1-S ±IG2-S			nA nA
Gate-source breakdown voltages $\pm I_{G1-S} = 10 \text{ mA}; V_{G2-S} = V_{DS} = 0$ $\pm I_{G2-S} = 10 \text{ mA}; V_{G1-S} = V_{DS} = 0$	±V(BR)G1-SS ±V(BR)G2-SS			
Drain current $V_{DS} = 15 \text{ V}$ ; $V_{G1-S} = 0$ ; $V_{G2-S} = 4 \text{ V}$	IDSS	4 to	20	mA
Gate-source cut-off voltages $I_D = 20 \mu A$ ; $V_{DS} = 15 V$ ; $+V_{G2-S} = 4 V$ $I_D = 20 \mu A$ ; $V_{DS} = 15 V$ ; $V_{G1-S} = 0$	-V(P)G1-S -V(P)G2-S		2,5 2,0	
DYNAMIC CHARACTERISTICS				
Measuring conditions (common source): $I_D = 10$ mA; $V_{DS} = 15$ \	/; +V <sub>G2-S</sub> = 4 \	/; T <sub>amb</sub> = 2	25 OC	<b>)</b> .
Transfer admittance at f = 1 kHz	Vfs	> typ.		mS mS
Input capacitance at gate 1: f = 1 MHz	C <sub>ig1-s</sub>	typ.		pF pF
Input capacitance at gate 2: f = 1 MHz	C <sub>ig2-s</sub>	typ.	1,2	pF
Feedback capacitance at f = 1 MHz	C <sub>rs</sub>	typ.	25	fF
Output capacitance at f = 1 MHz	Cos	typ.	1,0	pF
Noise figure at $G_S = 2$ mS and $f = 200$ MHz	F	typ.	1,0	dB

 $\mathsf{G}_\mathsf{p}$ 

25 dB

typ.

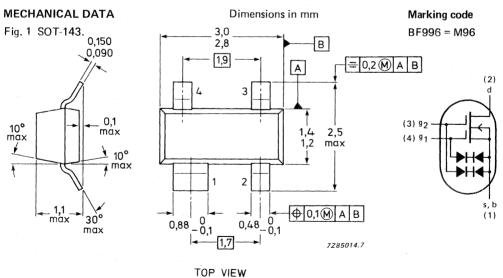
Power gain at  $G_S = 2 \text{ mS}$  $G_L = 0.5 \text{ mS}$ ; f = 200 MHz

Depletion type field-effect transistor in a plastic microminiature envelope, with source and substrate interconnected, intended for u.h.f. applications, such as television tuners and professional communication equipment.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

#### **QUICK REFERENCE DATA**

Drain-source voltage	$v_{DS}$	max.	20 V
Drain current (average)	<sup>I</sup> D(AV)	max.	30 mA
Total power dissipation up to $T_{amb} = 60$ °C	$P_{tot}$	max.	200 mW
Junction temperature	Τj	max.	150 °C
Transfer admittance at $f = 1 \text{ kHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	y <sub>fs</sub>	typ.	17 mS
Feedback capacitance at $f = 1 \text{ MHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	C <sub>rs</sub>	fyp.	25 fF
Noise figure at optimum source admittance $I_D = 10 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$ ; $f = 800 \text{ MHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$ ; $f = 200 \text{ MHz}$	F F	typ.	2,8 dB 1,5 dB



Drain-source voltage	$v_{DS}$	max.	20 V
Drain current (average)	l <sub>D(AV)</sub>	max.	30 mA
Gate 1-source current	± IG1-S	max.	10 mA
Gate 2-source current	± I <sub>G2-S</sub>	max.	10 mA
Total power dissipation up to T <sub>amb</sub> = 60 °C*	P <sub>tot</sub>	max.	200 mW
Storage temperature	T <sub>stg</sub>	65 to	+ 150 °C
Junction temperature		max.	150 °C



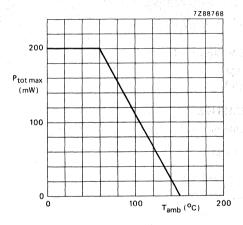


Fig. 2 Power derating curve.

<sup>\*</sup> Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

50 nA

#### STATIC CHARACTERISTICS

T<sub>amb</sub> = 25 °C unless otherwise specified Gate cut-off currents

gate 1;  

$$\pm V_{G1-S} = 5 V$$
;  $V_{G2-S} = V_{DS} = 0$   
gate 2;  
 $\pm V_{G2-S} = 5 V$ ;  $V_{G1-S} = V_{DS} = 0$ 

± I<sub>G2-SS</sub> < 50 nA

± IG1-SS

Gate-source breakdown voltages

gate 1;

$$\pm I_{G1-SS} = 10 \text{ mA}; V_{G2-S} = V_{DS} = 0$$

 $\pm$  V(BR)G1-SS 6 to 20 V

gate 2;

$$\pm$$
 I<sub>G2-SS</sub> = 10 mA; V<sub>G1-S</sub> = V<sub>DS</sub> = 0  
Gate-source cut-off voltages

± V(BR)G2-SS 6 to 20 V

ate-source cut-off voltages

gate 1;

$$I_D = 20 \mu A; V_{DS} = 15 V; + V_{G2-S} = 4 V$$

$$-V_{(P)G1-S}$$
 < 2,5 V

gate 2;  $I_D = 20 \mu A$ ;  $V_{DS} = 15 V$ ;  $V_{G1-S} = 0$ 

Drain-source cut-off voltage 
$$V_{DS} = 15 \text{ V}; V_{G2-S} = 4 \text{ V}$$

$$-V_{(P)G2-S}$$
 <

IDSS

#### DYNAMIC CHARACTERISTICS

Measuring conditions (common source):  $I_D = 10 \text{ mA}$ ;  $V_{DS} = 15 \text{ V}$ ;  $+ V_{G2-S} = 4 \text{ V}$ ;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ 

3 (,,,)	0	· · · · anno		
Transfer admittance at f = 1 kHz	y <sub>fs</sub>	> typ.	15 mS 17 mS	
Input capacitance at gate 1; f = 1 MHz	C <sub>ig1-s</sub>	typ.	2,2 pF	
Input capacitance at gate 2; f = 1 MHz	C <sub>ig2-s</sub>	typ.	1,1 pF	
Feedback capacitance at f = 1 MHz	C <sub>rs</sub>	typ.	25 fF	
Output capacitance at f = 1 MHz	Cos	typ.	0,8 pF	
Noise figure at G <sub>S</sub> = 2 mS, f = 200 MHz		typ.	1,5 dB	
at $G_S = 2 \text{ mS}$ , $f = 800 \text{ MHz}$		typ.	2,8 dB 3.9 dB	
Power gain $G_S = 2 \text{ mS}, G_L = 0.5 \text{ mS}, f = 200 \text{ MHz}$ $G_S = 2 \text{ mS}, G_L = 1.0 \text{ mS}, f = 800 \text{ MHz}$	G <sub>р</sub> G <sub>р</sub>	typ. typ.	25 dB 18 dB	

Depletion type field-effect transistor in a plastic microminiature envelope (SOT-143) with source and substrate interconnected and intended for u.h.f. applications in television tuners, using SMD\* technology. The device is also suitable for use in professional communication equipment.

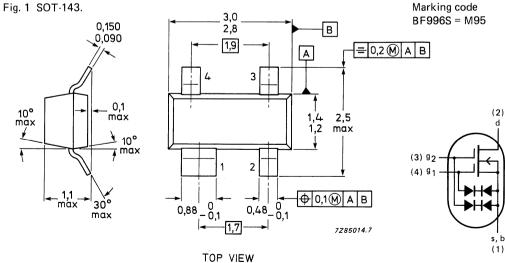
This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

#### \* Surface Mounted Devices

#### QUICK REFERENCE DATA

V <sub>DS</sub>	max.	20 V
۱D	max.	30 mA
$P_{tot}$	max.	300 mW
Тj	max.	150 °C
yfs	typ.	18 mS
C <sub>rs</sub>	typ.	25 fF
E	tvn	1.8 dB
	I <sub>D</sub> P <sub>tot</sub> T <sub>j</sub>	$P_{tot}$ max. $P_{tot}$ max. $T_j$ max. $P_{tot}$ $P_{tot}$ max. $P_{tot}$ $P_{tot}$ max. $P_{tot}$ $P_{$

## **MECHANICAL DATA**



Dimensions in mm

#### **RATINGS** Limiting values in accordance with the Absolute Maximum System (IEC 134) Drain-source voltage 20 V V<sub>DS</sub> max. 30 mA Drain current (d.c. or average) ΙD max. Gate 1 - source current ±IG1-S max. 10 mA Gate 2 - source current ±IG2-S 10 mA max. Total power dissipation 300 mW up to Tamb = 25 °C Ptot max. -65 to 150 °C Storage temperature Tstg 150 °C Junction temperature $T_i$ max. THERMAL RESISTANCE From junction to ambient in free air mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm 430 K/W Rth i-a STATIC CHARACTERISTICS T<sub>i</sub> = 25 °C unless otherwise specified Gate cut-off currents $\pm V_{G1-S} = 5 \text{ V}, V_{G2-S} = V_{DS} = 0$ 50 nA ±IG1-S $\pm V_{G2-S} = 5 V$ ; $V_{G1-S} = V_{DS} = 0$ ±IG2-S 50 nA Gate-source breakdown voltages ±V(BR)G1-SS 6,0 to 20 V $\pm I_{G1-S} = 10 \text{ mA}; V_{G2-S} = V_{DS} = 0$ 6,0 to 20 V $\pm I_{G2-S} = 10 \text{ mA}; V_{G1-S} = V_{DS} = 0$ ±V(BR)G2-SS Drain current 4 to 20 mA $V_{DS} = 15 \text{ V}; V_{G1-S} = 0; V_{G2-S} = 4 \text{ V}$ 1<sub>DSS</sub> Gate-source cut-off voltages

#### **DYNAMIC CHARACTERISTICS**

 $I_D = 20 \mu A$ ;  $V_{DS} = 15 \text{ V}$ ;  $+V_{G2-S} = 4 \text{ V}$ 

 $I_D = 20 \mu A$ ;  $V_{DS} = 15 V$ ;  $V_{G1-S} = 0$ 

Measuring conditions (common source): ID = 10 mA; VDS = 15 V; +VG2 S = 4 V; Tamb = 25 °C.

2,5 V

2,0 V

-V(P)G1-S

-V(P)G2-S

<

<

Transfer admittance at f = 1 kHz	y <sub>fs</sub>	> 15 n typ. 18 n	-
Input capacitance at gate 1: f = 1 MHz	Cig1-s	typ. 2,3 p < 2,6 p	
Input capacitance at gate 2: f = 1 MHz	C <sub>ig2-s</sub>	typ. 1,2 p	
Feedback capacitance at f = 1 MHz	C <sub>rs</sub>	typ. 25 f	
Output capacitance at f = 1 MHz	Cos	typ. 0,8 p	οF
Noise figure f = 200 MHz; G <sub>S</sub> = 2 mS f = 800 MHz; G <sub>S</sub> = 3,3 mS		typ. 1,0 c typ. 1,8 c	
Power gain $f = 200 \text{ MHz}$ ; $G_S = 2 \text{ mS}$ ; $G_L = 0.5 \text{ mS}$ $f = 800 \text{ MHz}$ ; $G_S = 3.3 \text{ mS}$ ; $G_L = 1.0 \text{ mS}$	Gp	typ. 25 c typ. 18 c	

This data sheet contains advance information and specifications are subject to change without notice.

## SILICON N-CHANNEL DUAL GATE MOS-FET

Depletion type field-effect transistor in a plastic microminiature envelope with source and substrate interconnected, intended for u.h.f. and v.h.f. applications, such as u.h.f./v.h.f. television tuners and professional communication equipment.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source and has an integrated drain resistance to suppress oscillation in the frequency range higher than 1 GHz.

This device is especially intended for use in pre-amplifiers in CATV tuners with a great tuning range up to 500 MHz.

#### QUICK REFERENCE DATA

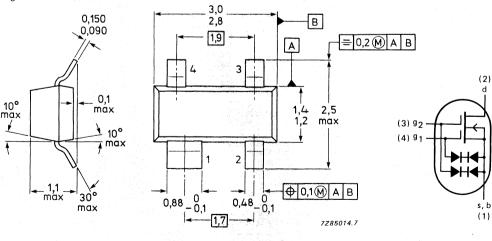
Drain-source voltage	$V_{DS}$	max.	20 V
Drain current (average)	<sup>I</sup> D(AV)	max.	30 mA
Total power dissipation up to $T_{amb} = 25  {}^{\circ}C$	$P_{tot}$	max.	300 mW
Junction temperature	Τj	max.	150 °C
Transfer admittance at $f = 1 \text{ kHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	y <sub>fs</sub>	typ.	18 mS
Feedback capacitance at $f = 1 \text{ MHz}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$	C <sub>rs</sub>	typ.	25 fF
Noise figure at $G_S = 2 \text{ mS}$ $I_D = 10 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $+ V_{G2-S} = 4 \text{ V}$ ; $f = 200 \text{ MHz}$	F	typ.	1,0 dB

#### **MECHANICAL DATA**

Fig. 1 SOT-143.

Dimensions in mm

Marking code: M83



Limiting values in accordance	with the	Absolute Maximum	System (IEC 134)

		The state of the s			
Drain-source vo	tage	$V_{DS}$	max.	20	V 1 1 1
Drain current (a	verage)	<sup>I</sup> D(AV)	max.	30	mΑ
Gate 1 source cu	urrent	± IG1-S	max.	10	mΑ
Gate 2 source cu	ırrent	±  G2-S	max.	10	mΑ
Total power dis	sipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	300	mW
Storage tempera	ture	T <sub>stg</sub>	-65 to +	150	oC
Junction temper	rature	$_{i^{lpha}}$ $^{i}$ $_{i^{lpha}}$ $^{i}$ $\mathbf{T_{j}}$ $_{i^{lpha}}$ $_{i^{lpha}}$ $_{i^{lpha}}$ $_{i^{lpha}}$ $_{i^{lpha}}$	max.	150	οС

## THERMAL RESISTANCE

From junction to ambient in free air*	D	_	430 K/W
From function to ambient in free air	Hth i-a	_	43U N/W
	11111-0		

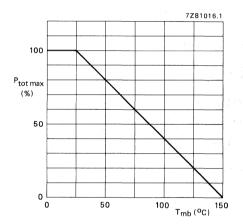


Fig. 2 Power derating curve.

 $<sup>^{*}</sup>$  Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

#### STATIC CHARACTERISTICS

Tamb = 25 °C unless otherwise specified

Gate cut-off currents

Drain-source cut-off voltage

$$V_{DS} = 15 \text{ V}; V_{G2-S} = 4 \text{ V}; V_{G1-S} = 0$$
  $I_{DSS}$  2 to 20 mA

## **DYNAMIC CHARACTERISTICS**

Measuring conditions (common source): ID = 10 mA; VDS = 15 V; + VG2-S = 4 V; Tamb = 25 °C > 15 mS Transfer admittance at f = 1 kHz  $|y_{fs}|$ 18 mS typ.

Input capacitance at gate 1; f = 1 MHz Ciq1-s typ. 2,5 pF Input capacitance at gate 2; f = 1 MHz 1,2 pF Ciq2-s typ. Feedback capacitance at f = 1 MHz  $C_{rs}$ typ. 25 fF Output capacitance at f = 1 MHz Cos 1,0 pF typ. Noise figure at f = 200 MHz; G<sub>S</sub> = 2 mS F typ. 1,0 dB

Power gain at  $G_S = 2 \text{ mS}$ 

$$G_L = 0.5$$
 mS,  $f = 200$  MHz  $G_D$  typ. 25 dB



## N-P-N 2 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a four-lead dual-emitter plastic envelope (SOT-143). It is designed for wideband application in the GHz range, such as satellite TV systems (SATV) and repeater amplifiers in fibre-optical systems. The device features a very high transition frequency, high gain and a very low noise figure up to high frequencies.

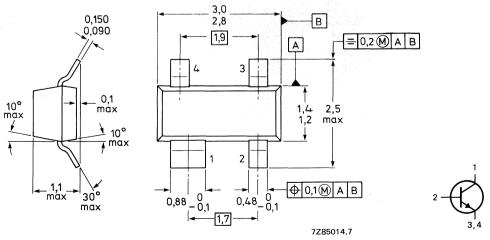
#### QUICK REFERENCE DATA

Collector-base voltage	$v_{CBO}$	max.	20 V
Collector-emitter-voltage	$V_{CEO}$	max.	10 V
Collector current (d.c.)	l <sub>C</sub>	max.	50 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	300 mW
Junction temperature	Tj	max.	150 °C
D.C. current gain $I_C = 15 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	hFE	min. typ.	60 100
Transition frequency at $f = 500 \text{ MHz}$ $I_C = 15 \text{ mA}$ ; $V_{CE} = 8 \text{ V}$	fT	typ.	7,5 GHz
Maximum unilateral power gain at $f = 2 \text{ GHz}$ $I_C = 15 \text{ mA}$ ; $V_{CE} = 8 \text{ V}$ ; $T_{amb} = 25 \text{ °C}$	G <sub>UM</sub>	typ.	10,0 dB
Noise figure at $f = 2 \text{ GHz}$ $Z_S = 60 \Omega$ ; $T_{amb} = 25 ^{\circ}\text{C}$			
$I_C = 5 \text{ mA}; V_{CE} = 8 \text{ V}$	F	typ.	2,5 dB
I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 8 V	F	typ.	3,0 dB

#### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOT-143.



TOP VIEW

RATINGS			
Limiting values in accordance with the Absolute Maximum System (II	EC 134)		
Collector-base voltage (open emitter)	V <sub>СВО</sub>	max.	20 V
Collector-emitter voltage (open base)	VCEO	max.	10 V
Emitter-base voltage (open collector)	VEBO	max.	2,5 V
Collector current (d.c.)	lC .	max.	50 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C mounted on a ceramic substrate of 8 mm x 10 mm x 0.7 mm	P <sub>tot</sub>	max.	300 mW
Storage temperature	T <sub>stg</sub>		+ 150 °C
Junction temperature	rstg T <sub>j</sub>	max.	150 °C
	.1	max.	100 0
THERMAL RESISTANCE			
From junction to ambient			
mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm	R <sub>th j-a</sub>		430 K/W
	''tn J-a		450 10/10
CHARACTERISTICS			
T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified			
Collector cut-off current I <sub>E</sub> = 0; V <sub>CB</sub> = 10 V	ICBO	max.	50 nA
D.C. current gain IC = 15 mA; V <sub>CE</sub> = 5 V	hFE	min. typ.	60 100
Transition frequency at $f = 500 \text{ MHz}$ I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 8 V	fT	typ.	7,5 GHz
Collector capacitance at f = 1 MHz  IE = Ie = 0; VCB = 8 V	C <sub>c</sub>	typ.	0,7 pF
Emitter capacitance at f = 1 MHz IC = I <sub>C</sub> = 0; V <sub>EB</sub> = 0,5 V	C <sub>e</sub>	typ.	1,3 pF
Feedback capacitance at f = 1 MHz IC = 0; VCE = 8 V	C <sub>re</sub>	typ.	0,5 pF
Maximum unilateral power gain (sre assumed to be zero)	-16	7,6	-,-
$G_{UM} = 10 \log \frac{ s_{fe} ^2}{[1- s_{ie} ^2][1- s_{oe} ^2]}$			
at I <sub>C</sub> = 15 mA; V <sub>CE</sub> = 8 V; f = 2 GHz; T <sub>amb</sub> = 25 °C	GUM	typ.	10,0 dB
Noise figures at $f = 800 \text{ MHz}$ ; $Z_S = \text{opt.}$ ; $T_{amb} = 25  {}^{\circ}\text{C}$ ; $V_{CE} = 8  \text{V}$			
$I_C = 5 \text{ mA}$	F	typ.	0,8 dB
I <sub>C</sub> = 15 mA	F	typ.	1,5 dB
Noise figures at f = 2 GHz; $Z_S = 60 \Omega$ $T_{amb} = 25  {}^{\circ}C$ ; $V_{CE} = 8  V$			
IC = 15 mA	F F	typ. typ.	2,5 dB 3,0 dB

s-parameters (common emitter) at  $V_{CE}$  = 8 V;  $T_{amb}$  = 25 °C; typical values.

			-			
I <sub>C</sub>	f MHz	sie	sfe	s <sub>re</sub>	soe	GUM dB
	40	0,96/ -6,80	5,8/177,80	0,01/ 84,50	0.99/ -3.20	44,1
	100	0,98/ -20,80	5,6/165,8°	0,03/ 77,50	1,01/ -10,00	46,5
	200	0,89/ -40,10	5,1/153,20	0,05/ 66,80	0,91/ -19,00	28,7
	500	0,81/ -89,30	4,3/121,50	0,09/ 43,40	0,79/ -38,50	21,5
2	800	0,68/-123,00	3,3/102,00	0,11/ 33,80	0,67/ -50,00	15,7
-	1000	0,64/139,90	2,8/ 89,80	0,11/ 28,00	0,65/ -54,50	13,7
	1200	0,60/-157,30	2,3/ 81,10	0,11/ 25,80	0,62/ -61,70	11,5
	1500	0,59/-173,30	2,0/ 71,80	0,11/ 27,40	0,55/ -69,30	9,5
	2000	0,57/+161,70	1,5/ 56,30	0,10/ 32,20	0,54/ -85,80	6,7
	40	0,91/ -10,90	13,5/174,80	0,01/ 83,30	0,98/ -5,90	44,2
	100	0,91/ -30,30	12,6/159,50	0,03/ 72,20	0,96/ -17,00	40,9
	200	0,79/ -56,3°	10,6/143,50	0,04/ 60,30	0,81/ -29,50	29,3
	500	0,64/-115,90	7,4/109,80	0,07/ 41,40	0,58/ -50,80	21,5
5	800	0,55/—145,5°	5,2/ 93,50	0,08/ 39,90	0,48/ -59,50	17,1
	1000	0,53/-161,40	4,2/ 84,00	0,08/ 39,10	0,44/ -62,20	15,0
	1200	0,52/-176,5°	3,5/ 77,80	0,08/ 41,20	0,42/ -67,10	13,1
	1500	0,51/+172,20	2,9/ 69,10	0,09/ 44,60	0,38/ -75,70	11,3
	2000	0,50/+149,80	2,2/ 56,70	0,11/ 49,80	0,38/ -89,50	8,7
		0.05/ 10.10	00 5 /4 70 00	0.04/.00.40	0.00/ 0.70	40.0
	40	0,85/ -16,19	23,5/170,60	0,01/ 80,10	0,96/ _9,70	43,8
	100	0,81/ -42,60	21,3/151,80	0,02/ 67,20	0,89/ -25,20	38,0
	200	0,67/ -76,30	16,6/133,00	0,04/ 55,50	0,68/ -40,00	29,6
	500	0,54/—137,50	9,5/101,50	0,05/ 45,70	0,42/ -60,20	21,9
10	800	0,49/—161,80	6,3/ 88,50	0,07/ 49,20	0,35/ -67,00	17,7
	1000	0,49/—175,20	5,1/ 80,50	0,07/ 50,60	0,32/ -68,90	15,8
	1200	0,49/+171,50	4,2/ 75,80	0,08/ 53,40	0,29/ -72,50	13,9
	1500	0,47/+163,50	3,5/ 67,50	0,09/ 55,30	0,28/ -82,10	12,3
	2000	0,47/+142,50	2,6/ 56,80	0,12/ 57,70	0,29/ —94,50	9,6
	40	0,80/ -20,10	31,0/167,80	0,01/ 76,40	0,94/ -12,20	43,5
	100	0,74/ -51,80	26,9/146,80	0,02/ 64,10	0,83/ -30,30	37,2
	200	0,60/ -89,40	19,9/126,70	0,03/ 54,00	0,60/ -45,50	29,8
	500	0,51/-147,50	10,3/ 98,00	0,05/ 49,70	0,35/ -64,90	22,1
15	800	0,47/-168,50	6,7/ 86,50	0,06/ 54,60	0,29/ -70,80	18,1
	1000	0,47/+179,20	5,4/ 79,30	0,07/ 55,90	0,27/ -72,80	16,1
	1200	0,48/+166,5°	4,4/ 75,00	0,08/ 58,40	0,24/ -75,80	14,3
	1500	0,46/+160,00	3,7/ 67,00	0,10/ 59,20	0,24/ -86,00	12,5
	2000	0,45/+139,5°	2,7/ 56,80	0,12/ 60,20	0,25/ -97,80	10,0
	40	0,76/ -23,8°	37,2/165,40	0,01/ 75,60	0,92/ -14,30	43,3
	100	0,69/ -60,00	31,2/142,60	0,02/ 61,70	0,78/ -34,30	36,8
	200	0,55/ -99,60	21,8/122,50	0,03/ 53,60	0,54/ -49,50	29,8
	500	0,49/—152,50	10,6/ 96,00	0,04/ 53,00	0,31/ -68,00	22,2
20	800	0,46/—172,90	7,0/ 85,00	0,06/ 58,10	0,26/ -73,30	18,2
	1000	0,46/+175,90	5,5/ 78,30	0,07/ 59,30	0,24/ -75,30	16,1
	1200	0,47/+163,50	4,6/ 74,30	0,08/ 61,50	0,21/ -78,30	14,5
	1500	0,45/+157,90	3,8/ 66,40	0,10/ 61,40	0,22/ -88,90	12,8
	2000	0,45/+137,80	2,8/ 56,70	0,12/ 61,70	0,22/—100,20	10,2

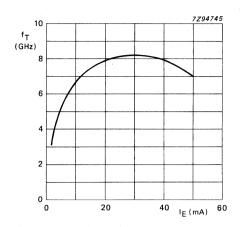


Fig. 2  $V_{CE}$  = 8 V; f = 500 MHz;  $T_{amb}$  = 25 °C; typical values.

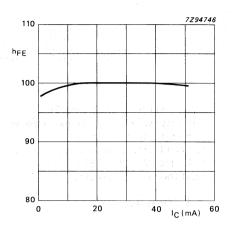


Fig. 3  $V_{CE} = 5 V$ ;  $T_{amb} = 25 °C$ ; typical values.

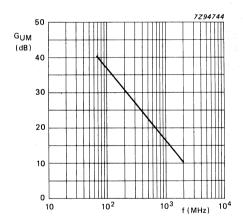


Fig. 4  $V_{CE}$  = 8 V; I<sub>C</sub> = 15 mA; T<sub>amb</sub> = 25 °C; typical values.

### N-P-N H.F. WIDEBAND TRANSISTOR

N-P-N multi-emitter transistor in a SOT-89 plastic envelope intended for application in thick and thin-film circuits. The transistor has extremely good intermodulation properties and a high power gain. It is primarily intended for:

- Output and driver stages of channel and band serial amplifiers with high output power for bands
   I, II, III and IV/V (40–860 MHz).
- Output and driver stages of wideband amplifiers.

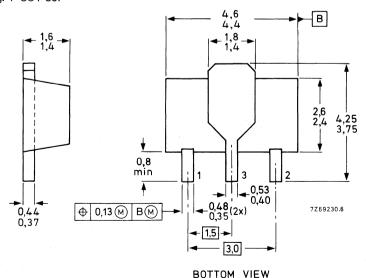
#### QUICK REFERENCE DATA

V <sub>СВОМ</sub>	max.	40 V
$V_{CEO}$	max.	25 V
I <sub>CM</sub>	max.	300 mA
$P_{tot}$	max.	1 W
Τį	max.	150 °C
fT	typ.	1, <b>2</b> GHz
C <sub>re</sub>	typ.	1,9 pF
	VCEO ICM Ptot Tj	$\begin{array}{lll} V_{CEO} & \text{max.} \\ I_{CM} & \text{max.} \\ P_{tot} & \text{max.} \\ T_j & \text{max.} \\ \end{array}$

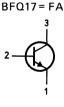
Dimensions in mm

### MECHANICAL DATA

Fig. 1 SOT-89.



Mark



See also Soldering recommendations.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter; peak value)	V <sub>CBOM</sub> max. 40 V
Collector-emitter voltage (RBE $\leq 50~\Omega$ ; peak value)	V <sub>CERM</sub> max. 40 V 1)
Collector-emitter voltage (open base)	V <sub>CEO</sub> max. 25 V 1)
Emitter-base voltage (open collector)	V <sub>EBO</sub> max. 2 V
Collector current (d.c.)	I <sub>C</sub> max. 150 mA
Collector current (peak value; $f > 1 \text{ MHz}$ )	I <sub>CM</sub> max. 300 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C mounted on a ceramic substrate	
area = $2,5 \text{ cm}^2$ ; thickness = $0,7 \text{ mm}$	P <sub>tot</sub> max. 1 W
Storage temperature	$T_{stg}$ -65 to +150 °C
Junction temperature	$T_j$ max. 150 oC
THERMAL RESISTANCE	·
From junction to collector tab	$R_{th j-tab} = 30 \text{ K/W}$
From junction to ambient in free air mounted on a ceramic substrate	
area = $2,5 \text{ cm}^2$ ; thickness = $0,7 \text{ mm}$	$R_{th j-a} = 125   K/W$

 $<sup>^{1}</sup>$ ) IC = 10 mA.

#### **CHARACTERISTICS**

T<sub>i</sub> = 25 °C unless otherwise specified

Collector cut-off current

$$I_{E} = 0$$
;  $V_{CB} = 20 \text{ V}$ ;  $T_{i} = 150 \text{ °C}$   $I_{CBO}$  max. 20 µA

Saturation voltage

$$I_C = 100 \text{ mA}$$
;  $I_B = 10 \text{ mA}$   $V_{CEsat}$  max. 0,5  $V$ 

D.C. current gain

Transition frequency at f = 500 MHz 1)

$$I_{C} = 150 \text{ mA}$$
;  $V_{CE} = 15 \text{ V}$  f<sub>T</sub> typ. 1,2 GHz

Collector capacitance at f = 1 MHz

$$I_E = I_e = 0$$
 ;  $V_{CB} = 15 \text{ V}$   $C_c$  max. 4 pF

Feedback capacitance at f = 1 MHz

$$I_C = 10 \text{ mA}; V_{CE} = 15 \text{ V}; T_{amb} = 25 \text{ }^{\circ}\text{C}$$
  $C_{re}$  typ. 1,9 pF

Max. unilateral power gain (sre assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{fe}|^2}{(1 - |s_{ie}|^2)(1 - |s_{oe}|^2)}$$

<sup>1)</sup> Measured under pulse conditions.

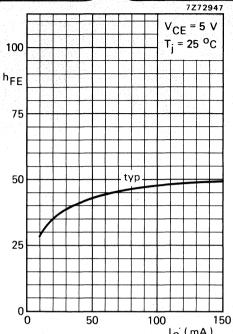
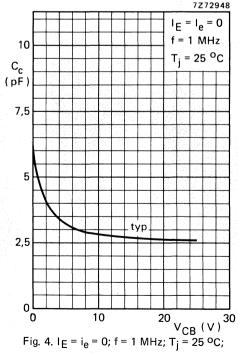


Fig. 2.  $V_{CE} = 5V$ ;  $T_j = 25 \, {}^{\circ}C$ ; typical values



typical values

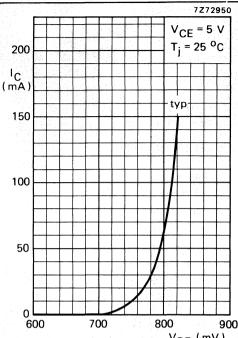
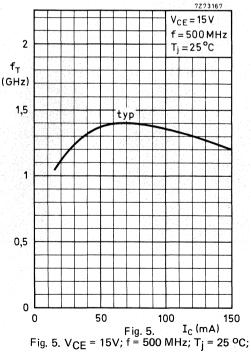


Fig. 3.  $V_{CE} = 5V$ ;  $T_j = 25 \, {}^{\circ}\text{C}$ ;  $V_{BE} \, (mV)$ typical values



typical values

# N-P-N H.F. WIDEBAND TRANSISTOR

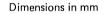
N-P-N transistor in a plastic SOT-89 envelope intended for application in thick and thin-film circuits. It is primarily intended for MATV purposes.

### **QUICK REFERENCE DATA**

measured at $f(p + q - r) = 793,25$ MHz	d <sub>im</sub>	max.	-60 dB
Intermodulation distortion IC = 80 mA; $V_{CF}$ = 10 V; $R_{L}$ = 75 $\Omega$			
Feedback capacitance at $f = 10,7 \text{ MHz}$ $I_C = 0; V_{CE} = 10 \text{ V}$	C <sub>re</sub>	typ.	1,2 pF
Transition frequency at f = 500 MHz I <sub>C</sub> = 100 mA; V <sub>CE</sub> = 10 V	fT	typ.	3,6 GHz
Junction temperature	$T_{j}$	max.	150 °C
Total power dissipation up to $T_{amb} = 25$ °C	P <sub>tot</sub>	max.	1 W
Collector current (d.c.)	IC	max.	150 mA
Collector-emitter voltage (open base)	V <sub>CEO</sub>	max.	15 V
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	25 V

### **MECHANICAL DATA**

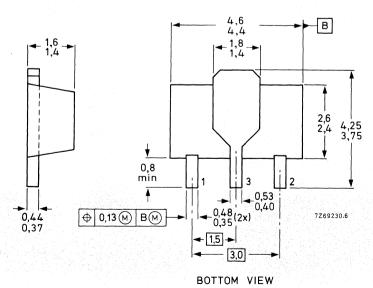
Fig. 1 SOT-89.











See also soldering recommendations

### **RATINGS**

HATINGS				
Limiting values in accordance with the Absolute Maximum System	(IEC 134)			
Collector-base voltage (open emitter)	$V_{CBO}$	max.	25	٧
Collector-emitter voltage (open base)	$V_{CEO}$	max.	15	٧
Emitter-base voltage (open collector)	$V_{EBO}$	max.	2	٧
Collector current (d.c.)	I <sub>C</sub>	max.	150	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C *	P <sub>tot</sub>	max.	1	W
Storage temperature	$T_{stg}$	-65 to +	150	oC
Junction temperature	$T_{j}$	max.	150	оС
THERMAL RESISTANCE				
From junction to collector tab	R <sub>th j-tab</sub>	=	25	K/W
From junction to ambient in free air *	R <sub>th j-a</sub>	= '	125	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
D.C. current gain **			0.5	
$I_C = 50 \text{ mA}; V_{CE} = 10 \text{ V}$ $I_C = 100 \text{ mA}; V_{CF} = 10 \text{ V}$	1 L	min. min.	25 25	
Transition frequency at f = 500 MHz **	"FE			
$I_C = 50 \text{ mA}; V_{CE} = 10 \text{ V}$	$f_{T}$	typ.	3,2	GHz
$I_C = 100 \text{ mA}; V_{CE} = 10 \text{ V}$	fT	typ.	3,6	GHz
Collector capacitance at f = 1 MHz	•		2.0	
$I_E = I_e = 0$ ; $V_{CB} = 10 \text{ V}$	C <sub>C</sub>	typ.	2,0	рF
Emitter capacitance at $f = 1 \text{ MHz}$ $I_C = I_C = 0$ ; $V_{FB} = 0.5 \text{ V}$	C <sub>e</sub>	typ.	11	pF
Feedback capacitance at f = 10,7 MHz	-e	-/1		
$I_C = 0$ ; $V_{CE} = 10 \text{ V}$	C <sub>re</sub>	typ.	1,2	pF

<sup>\*</sup> The device mounted on a ceramic substrate area = 2,5 cm²; thickness = 0,7 mm. \*\* Measured under pulse conditions.

Intermodulation distortion (see Fig. 2) I<sub>C</sub> = 80 mA; V<sub>CE</sub> = 10 V; R<sub>L</sub> = 75  $\Omega$  V<sub>p</sub> = V<sub>o</sub> = 700 mV at f<sub>p</sub> = 795,25 MHz V<sub>q</sub> = V<sub>o</sub> -6 dB at f<sub>q</sub> = 803,25 MHz V<sub>r</sub> = V<sub>o</sub> -6 dB at f<sub>r</sub> = 805,25 MHz Measured at f<sub>(p+q-r)</sub> = 793,25 MHz

 $d_{\mbox{im}}$  max.  $-60~\mbox{dB}$ 

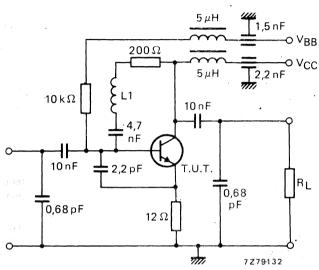


Fig. 2 MATV-test circuit (40-860 MHz).

### N-P-N 1 GHz WIDEBAND TRANSISTOR

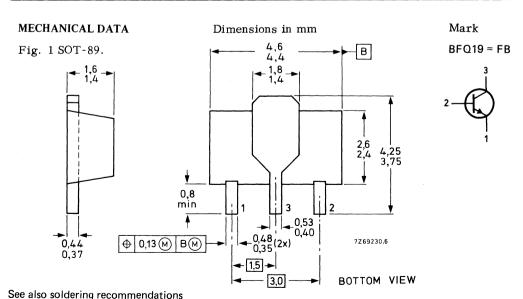
 $\mbox{N-P-N}$  transistor in a  $\mbox{SOT-89}$  plastic envelope intended for application in thick- and thin-film circuits.

It is primarily intended for use in u.h.f. and microwave amplifiers such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc.

The transistor features very low intermodulation distortion and high power gain. Thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

#### **QUICK REFERENCE DATA**

Collector-base voltage (open emitter)	$v_{CBO}$	max.	20	V
Collector-emitter voltage (open base)	$v_{\rm CEO}$	max.	15	V
Collector current (d.c.)	$^{\mathrm{I}}\mathrm{_{C}}$	max.	75	mA
Total power dissipation up to $T_{amb}$ = 87,5 $^{o}C$	$P_{tot}$	max.	500	mW
Junction temperature	$T_{\mathbf{j}}$	max.	150	<sup>o</sup> C
Transition frequency at f = 500 MHz $I_C$ = 50 mA; $V_{CE}$ = 10 V	$f_{\mathrm{T}}$	typ.	5	GHz
Feedback capacitance at f = 1 MHz $I_C = 10 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ;	$C_{re}$	typ.	1,3	pF
Noise figure at optimum source impedance $I_{C}$ = 50 mA; $V_{CE}$ = 10 V; f = 500 MHz;	F	typ.	3, 3	dB



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Collector-base voltage (open emitter)	$V_{CBO}$	max.	20	V
Collector-emitter voltage (open base)	$v_{\rm CEO}$	max.	15	V
Emitter-base voltage (open collector)	$v_{\rm EBO}$	max.	3,3	V
		, · · · · · · · · · · · · · · · · · · ·		ette kons
Collector current (d.c.)	$I_{\mathbf{C}}$	max.	75	mA
Collector current (peak value); $f > 1 \text{ MHz}$	$I_{CM}$	max.	150	mA
Total power dissipation up to T <sub>amb</sub> = 87,5 °C mounted on a ceramic substrate area = 2,5 cm <sup>2</sup> ; thickness = 0,7 mm	$P_{tot}$	max.	500	mW
Storage temperature	${ m T_{stg}}$	-65 to	+150	°C
Junction temperature	$^{\mathrm{T}}{}_{\mathrm{j}}$	max.	150	$^{\mathrm{o}}\mathrm{C}$
THERMAL RESISTANCE				
From junction to collector tab	R <sub>th j-tal</sub>	b = 1	40	K/W
From junction to ambient in free air mounted on a ceramic substrate				
area = $2,5 \text{ cm}^2$ ; thickness = $0,7 \text{ mm}$	$R_{thi-a}$	, <b>=</b> , ,	125	K/W

typ.

typ.

fT

52

5.5

GHz

#### CHARACTERISTICS

 $T_i$  = 25  $^{\circ}$ C unless otherwise specified

Collector cut-off current

$$I_E$$
 = 0:  $V_{CB}$  = 10  $V$   $I_{CBO}$  max. 100 nA

D.C. current gain 1)

$$I_{C}$$
 = 50 mA:  $V_{CE}$  = 10 V  $h_{FE}$   $min.$  25 typ. 50  $I_{C}$  = 75 mA:  $V_{CE}$  = 10 V  $h_{FE}$   $min.$  25 typ. 52

Transition frequency at f = 500 MHz 1)

$$I_{C}$$
 = 50 mA:  $V_{CE}$  = 10 V  $f_{T}$  min. 4, 0 GHz typ. 5, 0 GHz  $I_{C}$  = 75 mA:  $V_{CE}$  = 10 V  $f_{T}$  min. 4, 4 GHz

$$I_E = I_e = 0 : V_{CB} = 10 \text{ V}$$
  $C_c$  typ. 1,6 pF

Emitter capacitance at f = 1 MHz

$$I_C = I_c = 0 : V_{EB} = 0.5 \text{ V}$$
  $C_e$  typ. 5.0 pF

Feedback capacitance at f = 1 MHz

$$I_{C} = 10 \text{ mA}: V_{CE} = 10 \text{ V}: T_{amb} = 25 ^{\circ}C$$
  $C_{re}$  typ. 1,3 pF

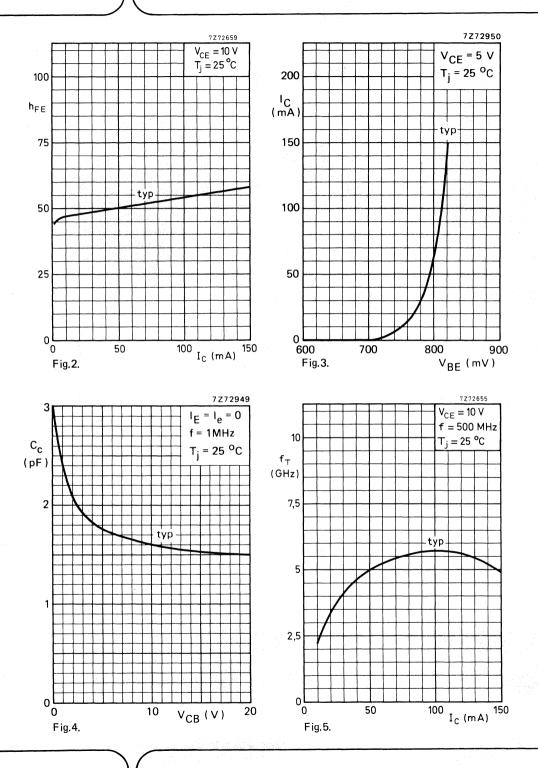
Noise figure at optimum source impedance

$$I_{C} = 50 \text{ mA}$$
:  $V_{CE} = 10 \text{ V}$ :  $f = 500 \text{ MHz}$ ;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$  F typ. 3,3 dB

Max. unilateral power gain (sre assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{fe}|^2}{(1 - |s_{ie}|^2)(1 - |s_{oe}|^2)}$$

<sup>1)</sup> Measured under pulse conditions.



### N-P-N 2 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope. It is designed for wideband application in the GHz range, such as satellite TV systems (SATV) and repeater amplifiers in fibre-optical systems. The device features a very high transition frequency and a very low noise figure up to high frequencies.

#### **QUICK REFERENCE DATA**

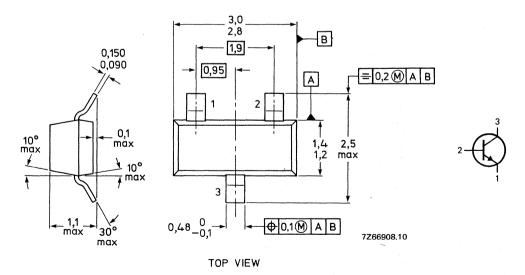
Collector-base voltage, open emitter	$v_{CBO}$	max.	20 V
Collector-emitter voltage, open base	$V_{CEO}$	max.	10 V
Collector current (d.c.)	<sup>I</sup> C	max.	50 mA
Total power dissipation up to T <sub>amb</sub> = 70 °C	P <sub>tot</sub>	max.	180 mW
Junction temperature	Τį	max.	150 °C
D.C. current gain $I_C = 15 \text{ mA}$ ; $V_{CB} = 5 \text{ V}$	hFE	typ.	100
Transition frequency at f = 500 MHz $I_C = 15 \text{ mA}$ ; $V_{CE} = 8 \text{ V}$	f <sub>T</sub>	typ.	7,5 GHz
Maximum unilateral power gain at $f = 2 \text{ GHz}$ $I_C = 15 \text{ mA}$ ; $V_{CE} = 8 \text{ V}$	G <sub>UM</sub>	typ.	8,0 dB

### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm

Mark: V2



If required, the R-version (reverse pinning) is available on request.

### **RATINGS**

HATINGS				
Limiting values in accordance with the Absolute	Maximum System	n (IEC 134)		
Collector-base voltage (open emitter)		V <sub>CBO</sub>	max.	20 V
Collector-emitter voltage (open base)		V <sub>CEO</sub>	max.	10 V
Emitter-base voltage (open collector)		VEBO	max.	2,5 V
Collector current (d.c.)		l <sub>C</sub>	max.	50 mA
Total power dissipation up to $T_{amb} = 70  {}^{\circ}\text{C}^{*}$		$P_{tot}$	max.	180 mW
Storage temperature		T <sub>stg</sub>	-65 to	+ 150 °C
Junction temperature		Tj	max.	150 °C
THERMAL RESISTANCE				
From junction to ambient in free air*		R <sub>th j-a</sub>	= :	430 K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified				
Collector cut-off current I <sub>E</sub> = 0; V <sub>CB</sub> = 5 V		Ісво	max.	50 nA
D.C. current gain $I_C = 15 \text{ mA}$ ; $V_{CB} = 5 \text{ V}$		hFE	typ.	100
Transition frequency at $f = 500 \text{ mHz}$ $I_C = 15 \text{ mA}$ ; $V_{CE} = 8 \text{ V}$		f <sub>T</sub>	typ.	7,5 GHz
Collector capacitance at $f = 1 \text{ MHz}$ $I_E = i_e = 0$ ; $V_{CB} = 8 \text{ V}$		C <sub>c</sub>	typ.	0,7 pF
Emitter capacitance at $f = 1 \text{ MHz}$ $I_C = I_C = 0$ ; $V_{EB} = 0.5 \text{ V}$		C <sub>e</sub>	typ.	1,3 pF
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 0$ ; $V_{CE} = 8 \text{ V}$		C <sub>re</sub>	typ.	0,5 pF
Maximum unilateral power gain (sre assumed to	be zero)			
$G_{UM} = 10 \log \frac{ s_{fe} ^2}{[1 -  s_{ie} ^2][1 -  s_{oe} ^2]}$				
$I_C = 15 \text{ mA}; V_{CE} = 8 \text{ V}; f = 2 \text{ GHz}; T_{amb} = 2$	5 °C	GUM	typ.	8,0 dB
Noise figure at $f = 2$ GHz; $R_S = 60 \Omega$ ; $T_{amb} = 25$				
$I_C = 5 \text{ mA}; V_{CE} = 8 \text{ V}$ $I_C = 15 \text{ mA}; V_{CE} = 8 \text{ V}$		F F	typ. typ.	2,5 dB 3,0 dB
			• •	

 $<sup>^{*}</sup>$  Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

s-parameters (common emitter) at  $V_{CE}$  = 8 V; typical values.

I <sub>C</sub> mA	f MHz	sie	s <sub>fe</sub>	s <sub>re</sub>	s <sub>oe</sub>	G <sub>UM</sub> dB
2	40	0,93/ -9,5°	7,07/174,6°	0,01/83,2°	1,00/ -4,5°	46,7
	100	0,90/ -22,8°	6,96/163,5°	0,03/76,3°	0,97/-10,4°	36,4
	200	0,84/ -42,1°	6,35/150,4°	0,06/66,4°	0,91/-17,9°	29,2
	500	0,61/ -90,7°	4,40/117,2°	0,10/45,7°	0,67/-32,6°	17,5
	800	0,55/-118,0°	3,24/102,6°	0,12/42,2°	0,60/-38,2°	13,7
	1000	0,54/-135,5°	2,7£,′ 93,5°	0,12/41,2°	0,55/-43,6°	11,9
	2000	0,47/ 177,3°	1,57/ 64,5°	0,15/60,0°	0,47/-65,3°	6,1
5	40 100 200 500 800 1000 2000	0,84/ -14,9° 0,78/ -36,1° 0,68/ -63,3° 0,45/-119,8° 0,42/-143,5° 0,43/-155,4° 0,35/ 169,2°	15,47/170,5° 14,35/154,8° 11,97/137,7° 6,74/106,1° 4,55/ 94,7° 3,80/ 87,4° 2,04/ 63,5°	0,01/80,7° 0,03/71,1° 0,05/60,6° 0,08/49,7° 0,09/53,8° 0,10/56,1° 0,18/69,4°	0,99/ -7,9° 0,92/-18,0° 0,79/-29,0° 0,47/-40,1° 0,41/-41,5° 0,37/-46,7° 0,34/-63,3°	44,5 35,4 28,5 18,6 14,8 13,1 7,3
10	40	0,74/ -22,8°	25,66/165,6°	0,01/77,5°	0,96/-12,1°	43,0
	100	0,65/ -51,2°	22,19/145,5°	0,03/66,8°	0,84/-26,3°	34,6
	200	0,53/ -85,2°	16,35/126,4°	0,04/58,1°	0,64/-38,4°	28,0
	500	0,38/-144,4°	8,01/ 99,5°	0,06/58,0°	0,33/-42,8°	19,2
	800	0,36/-161,9°	5,29/ 90,0°	0,09/64,0°	0,30/-41,2°	15,5
	1000	0,38/ 169,9°	4,27/ 84,0°	0,10/66,0°	0,27/-47,0°	13,6
	2000	0,30/ 160,0°	2,29/ 62,8°	0,20/72,6°	0,27/-61,2°	7,9
15	40 100 200 500 800 1000 2000	0,67/ -28,3° 0,57/ -62,8° 0,46/ -99,5° 0,36/-154,8° 0,34/ 169,3° 0,36/ 176,8° 0,29/ 155,7°	32,67/162,1 <sup>0</sup> 26,66/139,6 <sup>0</sup> 18,35/120,6 <sup>0</sup> 8,49/ 96,8 <sup>0</sup> 5,55/ 88,4 <sup>0</sup> 4,47/ 82,5 <sup>0</sup> 2,37/ 62,3 <sup>0</sup>	0,01/75,8° 0,02/64,6° 0,04/58,7° 0,06/62,9° 0,09/68,4° 0,10/69,7° 0,21/73,4°	0,94/-14,9° 0,78/-31,4° 0,56/-42,8° 0,27/-42,8° 0,26/-39,7° 0,23/-46,3° 0,25/-59,8°	42,5 34,2 27,9 19,5 15,7 13,9 8,2
20	40	0,63/ -32,5°	37,50/159,40	0,01/74,2°	0,93/-17,2°	42,0
	100	0,52/ -70,8°	29,23/135,50	0,02/63,4°	0,73/-34,7°	34,0
	200	0,42/-108,8°	19,22/117,40	0,03/59,7°	0,50/-45,0°	27,8
	500	0,35/-162,0°	8,69/ 95,00	0,06/64,9°	0,23/-41,6°	19,6
	800	0,33/-175,1°	5,62/ 86,90	0,09/70,7°	0,24/-38,1°	15,7
	1000	0,36/-178,7°	4,57/ 81,70	0,10/71,6°	0,21/-45,0°	14,0
	2000	0,28/-153,5°	2,40/ 62,00	0,21/73,8°	0,24/-58,9°	8,2

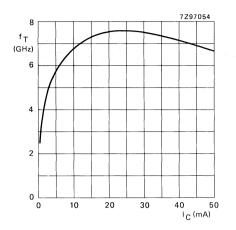


Fig. 2  $V_{CE} = 8 V$ ; f = 500 MHz; typical values.

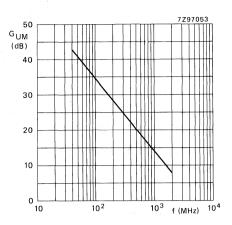


Fig. 3  $V_{CE}$  = 8 V;  $I_{C}$  = 15 mA;  $T_{amb}$  = 25 °C; typical values.

### N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

Planar epitaxial junction field effect transistor in a microminiature plastic envelope. It is intended for low level general purpose amplifiers in thick and thin-film circuits.

#### **QUICK REFERENCE DATA**

Drain-source voltage  Gate-source voltage (open drain)  Total power dissipation up to T <sub>amb</sub> = 65 °C	± V <sub>DS</sub> -V <sub>GSO</sub> P <sub>tot</sub>	max. max. max.	25 25 250		V V mW
Drain current $V_{DS} = 10 \text{ V}; V_{GS} = 0$	I <sub>DSS</sub>	> <	BFR30 4 10	1 5	mA mA
Transfer admittance (common source) $I_D = 1 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$ ; $f = 1 \text{ kHz}$	Yfs	> <	1,0 4,0	1,5 4,5	mS mS

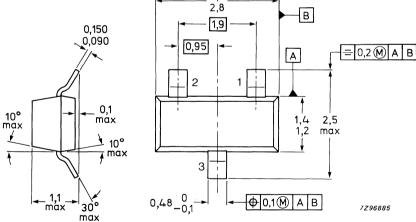
# MECHANICAL DATA

Fig. 1 SOT-23.

Dimensions in mm

Marking code

BFR30 = M1 BFR31 = M2



TOP VIEW

3,0

See also Soldering recommendations.

### **RATINGS**

Limiting values in accordance with the	Absolute Maximum System (IEC 134)
--	-----------------------------------

Drain-source voltage see Fig. 2	$^{\pm}$ V <sub>DS</sub>	max.	25	V
Drain-gate voltage (open source) see Fig. 2	$V_{DGO}$	max.	25	V
Gate-source voltage (open drain) see Fig. 2	$-V_{GSO}$	max.	25	V
Drain current	ID	max.	10	, mA
Gate current	IG	max.	5	mA
Total power dissipation up to $T_{amb} = 65  {}^{\circ}C^{**}$	$P_{tot}$	max.	250	mW
Storage temperature range	$T_{stg}$	65	to + 175	oC
Junction temperature	T;	max.	175	οС

### THERMAL CHARACTERISTICS\*

$$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$

### Thermal resistance

From junction to tab	R <sub>th j-t</sub>	=	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W

### CHARACTERISTICS

 $T_i = 25$  °C unless otherwise specified

Gate cut-off current			BFR30	BFR31	
$-V_{GS} = 10 \text{ V; } V_{DS} = 0$	-I <sub>GSS</sub>	<	0,2	0,2	nA
Drain current $V_{DS} = 10 V$ ; $V_{GS} = 0$	IDSS	> <	4 10	1 5	mA mA
Gate-source voltage $I_D = 1 \text{ mA}$ ; $V_{DS} = 10 \text{ V}$	-V <sub>GS</sub>	> <	0,7 3,0	0 1,3	V V
$I_D = 50 \mu\text{A};  V_{DS} = 10 \text{V}$	$-v_{GS}$	<	4,0	2,0	V
Gate-source cut-off voltage $I_D = 0.5 \text{ nA}$ ; $V_{DS} = 10 \text{ V}$	-V <sub>(P)GS</sub>	<	5	2,5	V
y parameters					
Transfer admittance at f = 1 kHz; $T_{amb}$ = 25 °C $I_D$ = 1 mA; $V_{DS}$ = 10 V	Yfs	> <	1,0 4,0	1,5 4,5	mS mS
$I_D = 200 \mu\text{A};  V_{DS} = 10 \text{V}$	Yfs	>	0,5	0,75	mS
Output admittance at f = 1 kHz I <sub>D</sub> = 1 mA; V <sub>DS</sub> = 10 V	Yos	<	40	25	μS
$I_D = 200 \mu\text{A}; V_{DS} = 10 V$	Yos	<	20	15	μS

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

### y parameters (continued)

			BFR30	BFR31	
Input capacitance at f = 1 MHz				ļ	
$I_D = 1 \text{ mA}; V_{DS} = 10 \text{ V}$	$c_{is}$	<	4	4	рF
$I_D = 200 \mu\text{A};  V_{DS} = 10 \text{V}$	$\mathrm{C}_{is}$	<	4	4	pΕ
Feedback capacitance at f = 1 MHz; Tamb = 25 °C					
$I_D = 1 \text{ mA}; V_{DS} = 10 \text{ V}$	$C^{L2}$	<	1,5	1,5	рF
$I_D = 200 \mu\text{A};  V_{DS} = 10 \text{V}$	$c_{\rm rs}$	<	1,5	1,5	рF
Equivalent noise voltage					
I <sub>D</sub> = 200 μA; V <sub>DS</sub> = 10 V					
B = 0.6 to 100 Hz	$v_n$	<	0,5	0,5	μV

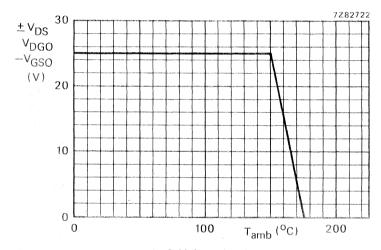


Fig. 2 Voltage derating curve.

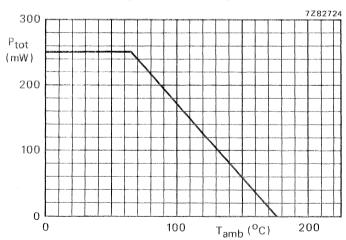


Fig. 3 Power derating curve.

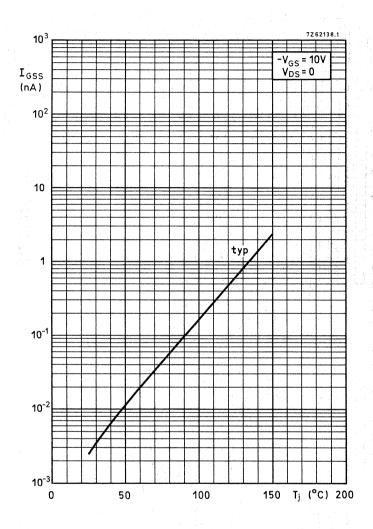


Fig. 4.

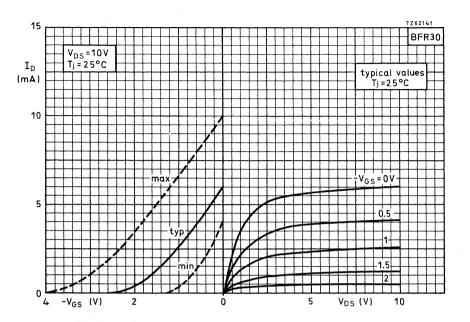


Fig. 5.

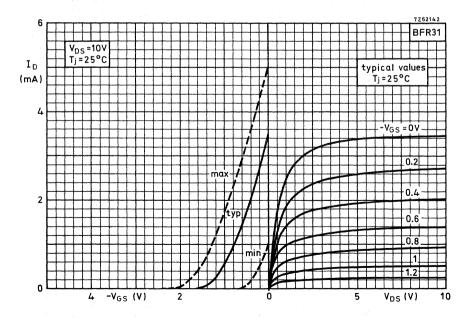


Fig. 6.

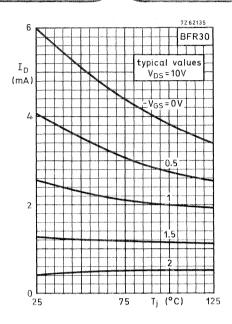


Fig. 7.

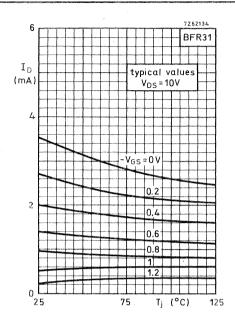


Fig. 8.

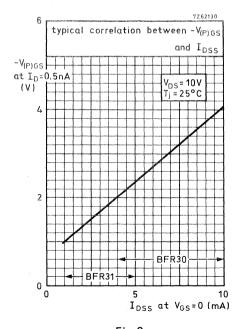
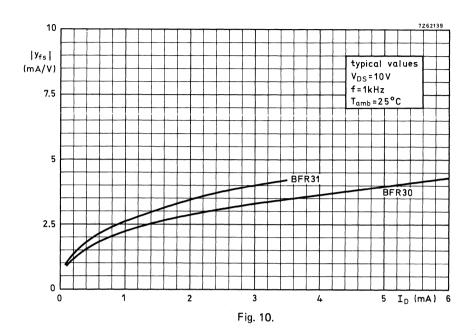
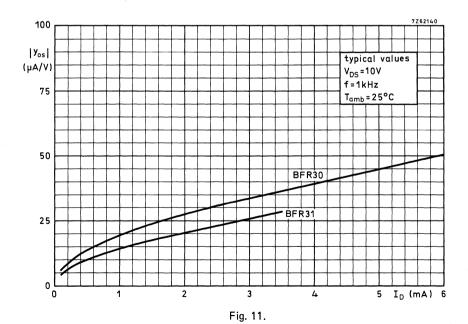


Fig. 9.





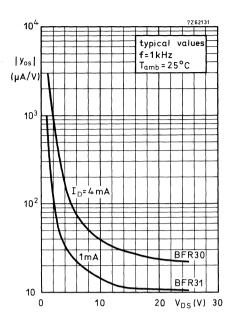


Fig. 12.

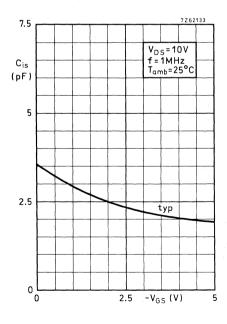


Fig. 13.

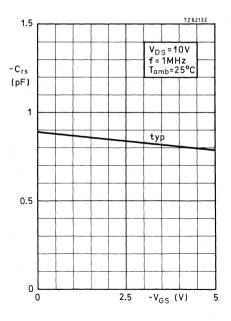


Fig. 14.

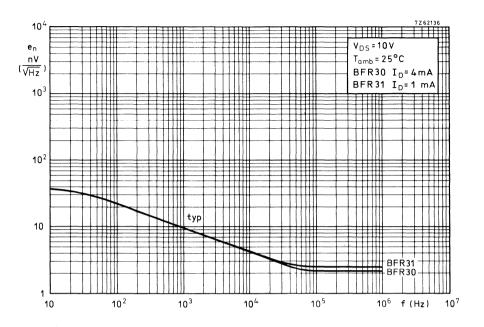


Fig. 15.

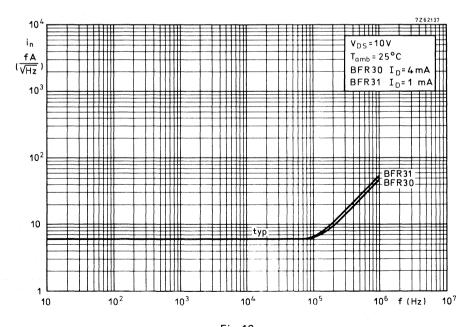


Fig. 16.

### N-P-N H.F. WIDEBAND TRANSISTOR

N-P-N multi-emitter transistor in a plastic SOT-23 envelope intended for application in thick and thin-film circuits. The transistor has very low intermodulation distortion and very high power gain. It is primarily intended for:

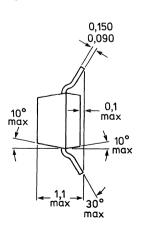
- Wideband vertical amplifiers in high speed oscilloscopes.
- Television distribution amplifiers.

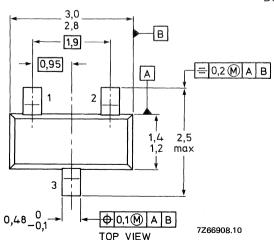
#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	VCBO	max.	18 V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	10 V
Collector current (peak value; $f > 1 \text{ MHz}$ )	<sup>1</sup> CM	max.	100 mA
Total power dissipation up to T <sub>amb</sub> = 65 °C	$P_{tot}$	max.	250 mW
Junction temperature	Τį	max.	175 °C
Feedback capacitance at f = 1 MHz I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V	C <sub>re</sub>	typ.	 0,9 pF
Transition frequency at $f = 500 \text{ MHz}$ $I_C = 25 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	fT	typ.	2,0 GHz
Max. unilateral power gain $I_C = 30 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 200 \text{ MHz}$ $I_C = 30 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 800 \text{ MHz}$	GUM GUM	typ. typ.	22 dB 10,5 dB
Intermodulation distortion at $T_{amb}$ = 25 °C $I_C$ = 30 mA; $V_{CE}$ = 5 V; $R_L$ = 37,5 $\Omega$ $V_o$ = 100 mV at $f_p$ = 183 MHz $V_o$ = 100 mV at $f_q$ = 200 MHz			
measured at $f(2q-p) = 217 \text{ MHz}$	d <sub>im</sub>	typ.	-60 dB

### **MECHANICAL DATA**

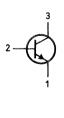
Fig. 1 SOT-23.





Dimensions in mm

Marking code BFR53 = N1



If required, the R-version (reverse pinning) is available on request.

## BFR53

### **RATINGS**

	- 404			
Limiting values in accordance with the Absolute Maximum System (IE	C 134)			
Collector-base voltage (open emitter) see Fig. 3	V <sub>CBO</sub>	max.	18	V
Collector-emitter voltage (open base) see Fig. 3	V <sub>CEO</sub>	max.	10	٧
Emitter-base voltage (open collector) see Fig. 3	$V_{EBO}$	max.	2,5	V
Collector current (d.c.)	l <sub>C</sub>	max.	50	mΑ
Collector current (peak value: f > 1 MHz)	ICM	max.	100	mΑ
Total power dissipation up to T <sub>amb</sub> = 65 °C**	P <sub>tot</sub>	max.	250	mW
Storage temperature	$T_{stg}$	-65 to	+ 175	oC
Junction temperature	Tj	max.	175	oC
THERMAL RESISTANCE *				
From junction to ambient**	R <sub>th j-a</sub>	=	430	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
I <sub>E</sub> = 0; V <sub>CB</sub> = 10 V	ІСВО	max.	50	nΑ
D.C. current gain				
I <sub>C</sub> = 25 mA; V <sub>CE</sub> = 5 V	hFE	min.	25 25	
IC = 50 mA; VCE = 5 V	hFE	min.	25	
Transition frequency at $f = 500 \text{ MHz}$ IC = 25 mA; VCE = 5 V	fŢ	typ.	2.0	GHz
Collector capacitance at f = 1 MHz	; <b>!</b>	-,,	_,-	-,
I <sub>E</sub> = I <sub>e</sub> = 0; V <sub>CB</sub> = 5 V	$C_{c}$	typ.	0,9	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0; V_{EB} = 0.5 \text{ V}$	Ce	typ.	1,5	рF
Feedback capacitance at f = 1 MHz	0		0.0	
$I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}; T_{amb} = 25 \text{ °C}$	Cre	typ.	0,9	þΓ

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

### Noise figure at f = 500 MHz ▲

$$I_C = 2 \text{ mA}$$
;  $V_{CE} = 5 \text{ V}$ ;  $T_{amb} = 25 \text{ °C}$   
 $G_S = 20 \text{ mS}$ ;  $B_S$  is tuned

### Max. unilateral power gain (sre assumed to be zero)

$$\begin{split} G_{UM} = 10 \, \log \, \frac{|s_{fe}|^2}{[1 - |s_{ie}|^2] \, [1 - |s_{oe}|^2]} \\ I_C = 30 \, \text{mA; V}_{CE} = 5 \, \text{V; f} = 200 \, \text{MHz; T}_{amb} = 25 \, ^{\text{OC}} \\ I_C = 30 \, \text{mA; V}_{CE} = 5 \, \text{V; f} = 800 \, \text{MHz; T}_{amb} = 25 \, ^{\text{OC}} \\ G_{UM} \qquad \text{typ.} \qquad 22 \, \text{dB} \\ G_{UM} \qquad \text{typ.} \qquad 10.5 \, \text{dB} \end{split}$$

#### Intermodulation distortion A

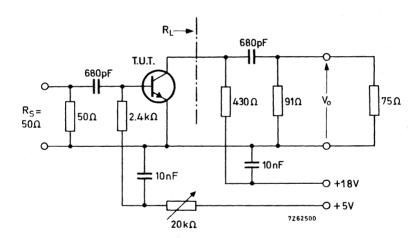


Fig. 2 Test circuit.

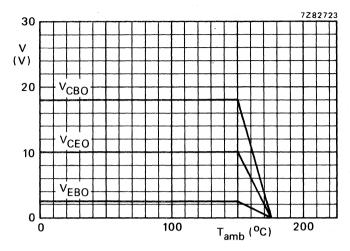


Fig. 3 Voltage derating curves.

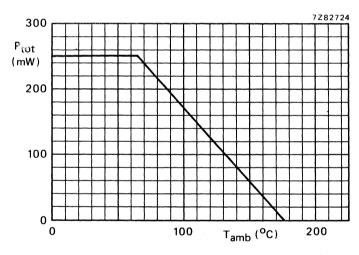


Fig. 4 Power derating curve.

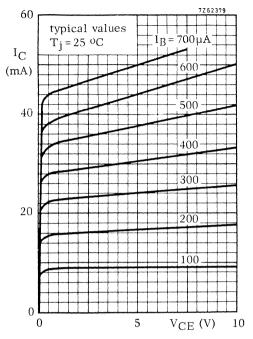


Fig. 5  $T_j = 25$  °C; typical values.

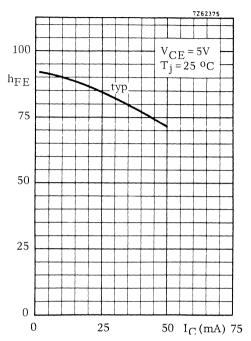


Fig. 6  $V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \text{ °C}$ ; typical values.

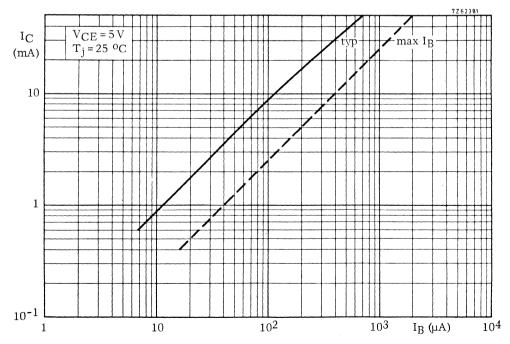


Fig. 7  $V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \text{ °C}$ .

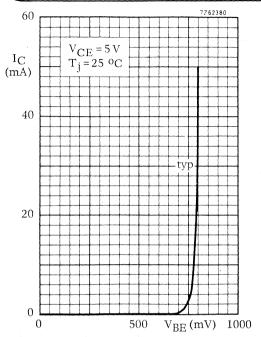


Fig. 8  $V_{CE} = 5 \text{ V}$ ;  $T_i = 25 \text{ °C}$ ; typical values.

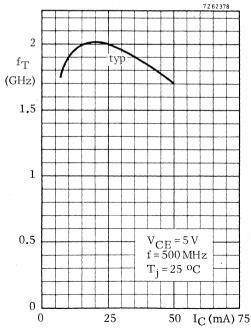


Fig. 9  $V_{CE}$  = 5 V; f = 500 MHz; T<sub>j</sub> = 25 °C; typical values.

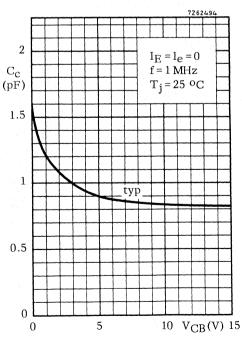


Fig. 10  $I_E = i_e = 0$ ; f = 1 MHz;  $T_i = 25$  °C; typical values.

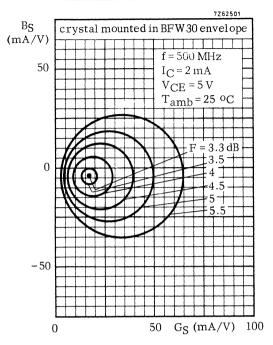


Fig. 11 Circles of constant noise figure;  $V_{CE} = 5 \text{ V}$ ;  $I_{C} = 2 \text{ mA}$ ; f = 500 MHz;  $T_{amb} = 25 \text{ °C}$ ; typ. values.

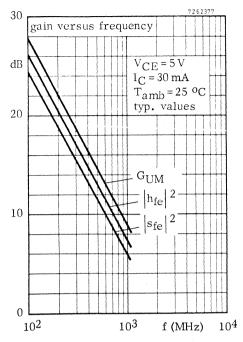
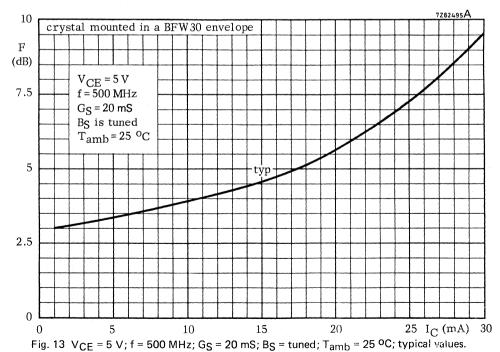


Fig. 12  $V_{CE} = 5 \text{ V}$ ;  $I_{C} = 30 \text{ mA}$ ;  $T_{amb} = 25 \text{ °C}$ ; typical values.



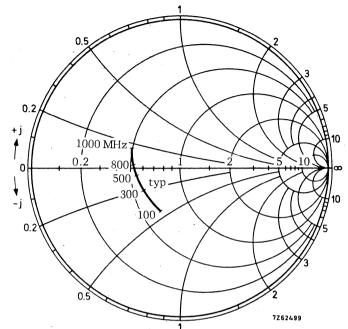


Fig. 14  $V_{CE}$  = 5 V;  $I_{C}$  = 30 mA;  $T_{amb}$  = 25 °C; typical values.

Input impedance derived from input reflection coefficient sie coordinates in ohm x 50.

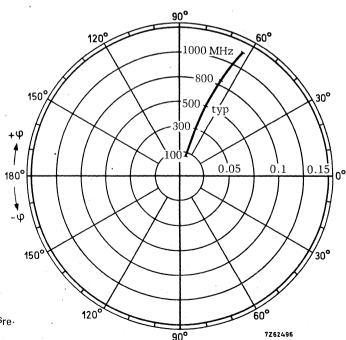


Fig. 15  $V_{CE}$  = 5 V;  $I_{C}$  = 30 mA;  $T_{amb}$  = 25 °C; typical values.

Reverse transmission coefficient  $s_{\mbox{\scriptsize re}}.$ 

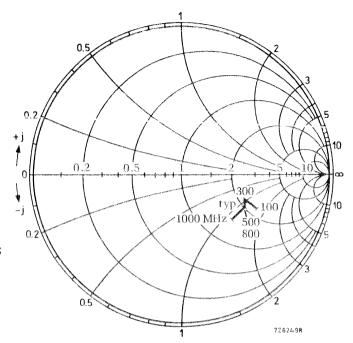


Fig. 16  $V_{CE}$  = 5 V;  $I_{C}$  = 30 mA;  $T_{amb}$  = 25 °C; typical values.

Output impedance derived from output reflection coefficient  $s_{\mbox{\scriptsize oe}}$  coordinates in ohm x 50.

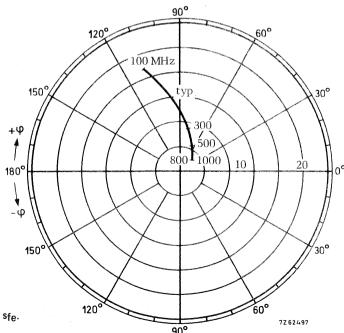


Fig. 17  $V_{CE} = 5 \text{ V}$ ;  $I_{C} = 30 \text{ mA}$ ;  $T_{amb} = 25 \,^{\circ}\text{C}$ ; typical values.

Forward transmission coefficient  $s_{\mbox{\scriptsize fe}}$ .

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# N-P-N 1 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc. The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

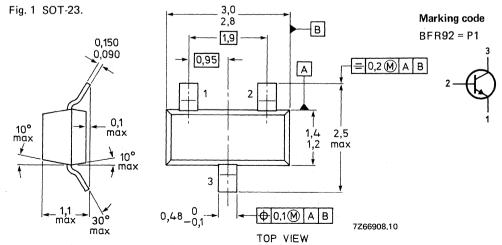
P-N-P complement is BFT92.

## QUICK REFERENCE DATA

V <sub>CBO</sub>	max.	20 V
$v_{CEO}$	max.	15 V
Ic	max.	25 mA
$P_{tot}$	max.	200 mW
Τj	max.	150 °C
fŢ	typ.	5,0 GHz
C <sub>re</sub>	typ.	0,4 pF
F	typ.	2,4 dB
GUM	typ.	18,0 dB
Vo	typ.	150 mV
	VCEO IC Ptot Tj fT Cre F	$\begin{array}{ccc} V_{CEO} & \text{max.} \\ I_{C} & \text{max.} \\ P_{tot} & \text{max.} \\ T_{j} & \text{max.} \\ \end{array}$ $\begin{array}{ccc} f_{T} & \text{typ.} \\ \\ C_{re} & \text{typ.} \\ \\ F & \text{typ.} \\ \end{array}$ $\begin{array}{ccc} G_{UM} & \text{typ.} \\ \end{array}$

## **MECHANICAL DATA**

Dimensions in mm



If required, the R-version (reverse pinning) is available on request.

# RATINGS

RATINGS				
Limiting values in accordance with the Absolute Maximum System (	IEC 134)			
Collector-base voltage (open emitter)	$V_{CBO}$	max.	20	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	15	V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	2	V
Collector current (d.c.)	<sup>I</sup> C	max.	25	mΑ
Total power dissipation up to Tamb = 60 °C**	P <sub>tot</sub>	max.	200	mW
Storage temperature	$T_{stg}$	-65 to +	150	oC
Junction temperature	$T_{j}$	max.	150	oC
THERMAL RESISTANCE*				
From junction to ambient**	R <sub>th j-a</sub>	=	430	K/W
CHARACTERISTICS				
$T_{j}$ = 25 °C unless otherwise specified				
Collector cut-off current				_
$I_E = 0$ ; $V_{CB} = 10 \text{ V}$	ICBO	max.	50	nΑ
D.C. current gain $I_C = 14 \text{ mA; V}_{CF} = 10 \text{ V}$	hff	min.	25	
		typ.	50	
Transition frequency at f = 500 MHz  IC = 14 mA; VCF = 10 V	fŢ	typ.	5.0	GHz
Collector capacitance at f = 1 MHz	' }	typ.	5,0	UIIZ
$I_E = I_e = 0$ ; $V_{CB} = 10 \text{ V}$	$C_{\mathbf{c}}$	typ.	0,75	pF
Emitter capacitance at f = 1 MHz	_			
$I_{C} = I_{c} = 0$ ; $V_{EB} = 0.5 \text{ V}$	Ce	typ.	8,0	pF.
Feedback capacitance at f = 1 MHz	0		0.4	
$I_C = 2 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $T_{amb} = 25 ^{o}\text{C}$	C <sub>re</sub>	typ.	0,4	рF

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

2,4 dB

150 mV

Noise figure at optimum source impedance\*

$$I_C = 2 \text{ mA}$$
;  $V_{CE} = 10 \text{ V}$ ;  $f = 500 \text{ MHz}$ ;  $T_{amb} = 25 \text{ oC}$ 

Max. unilateral power gain (sre assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{fe}|^2}{[1 - |s_{ie}|^2][1 - |s_{oe}|^2]}$$

G<sub>UM</sub> typ. 18,0 dB

typ.

typ.

F

Va

Output voltage at  $d_{im} = -60 \text{ dB}$  (see Fig. 2)

(DIN 45004B; par. 6.3.: 3-tone)

$$I_C$$
 = 14 mA;  $V_{CE}$  = 10 V;  $R_L$  = 75  $\Omega$ 

$$V_p$$
 =  $V_o$  at  $d_{im}$  =  $-60$  dB ;  $f_p$  = 495,25 MHz  $V_q$  =  $V_o$   $-6$  dB ;  $f_q$  = 503,25 MHz

$$V_r = V_0 - 6 \text{ dB}$$
 ;  $f_r = 505,25 \text{ MHz}$ 

measured at  $f_{(p+q-r)} = 493,25 \text{ MHz}$ 

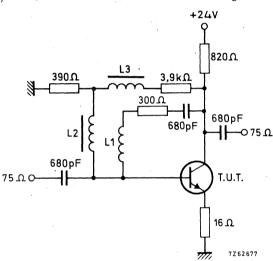


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35 mm); winding pitch 1 mm; int. dia. 4 mm L2 = L3 = 5  $\mu$ H (code number: 3122 108 20150)

<sup>\*</sup> Crystal mounted in a BFR90 envelope.

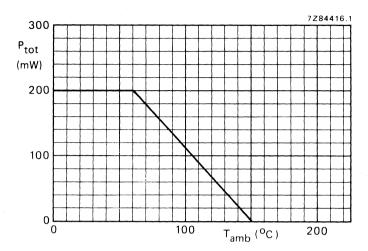


Fig. 3 Power derating curve.

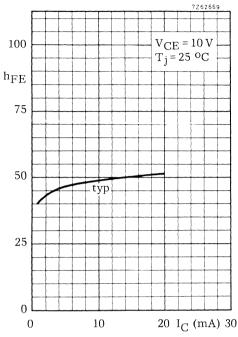


Fig. 4  $V_{CE}$  = 10 V;  $T_j$  = 25 °C; typical values.

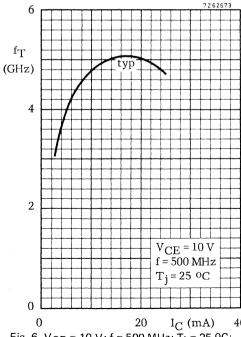


Fig. 6  $V_{CE} = 10 \text{ V}$ ; f = 500 MHz;  $T_j = 25 \text{ °C}$ ; typical values.

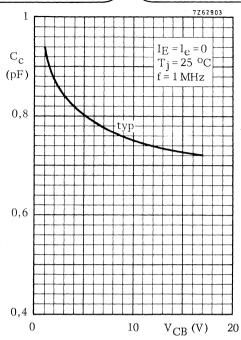


Fig. 5  $I_E = I_e = 0$ ; f = 1 MHz;  $T_j = 25 \text{ }^{\circ}\text{C}$ ; typical values.

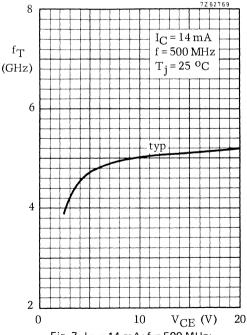


Fig. 7  $I_C = 14 \text{ mA}$ ; f = 500 MHz;  $T_i = 25 \text{ °C}$ ; typical values.

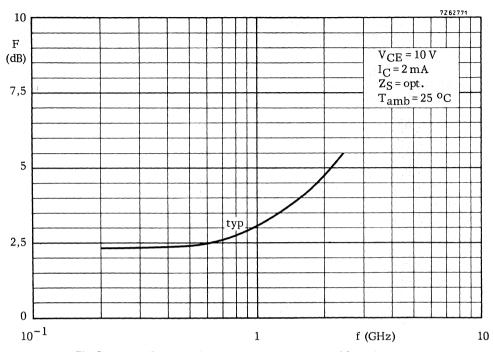


Fig. 8  $V_{CE}$  = 10 V;  $I_{C}$  = 2 mA;  $Z_{S}$  = opt.;  $T_{amb}$  = 25 °C; typical values.

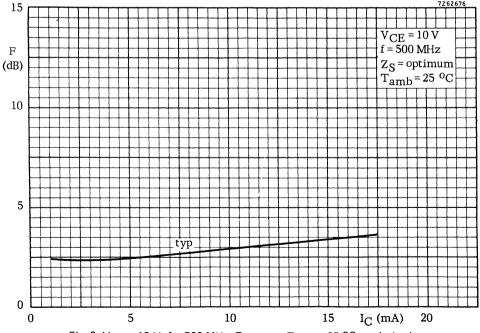


Fig. 9  $V_{CE}$  = 10 V; f = 500 MHz;  $Z_S$  = opt.;  $T_{amb}$  = 25 °C; typical values.

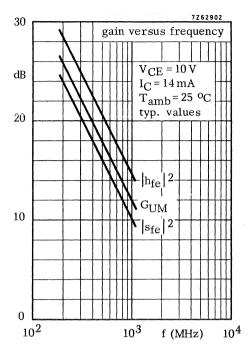


Fig. 10  $V_{CE}$  = 10 V;  $I_{C}$  = 14 mA;  $T_{amb}$  = 25 °C; typical values.

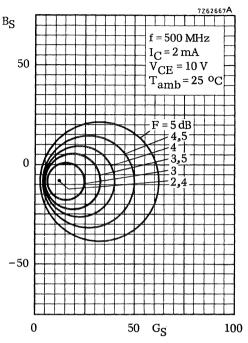


Fig. 11 Circles of constant noise figure;  $V_{CE} = 10 \text{ V}$ ;  $I_{C} = 2 \text{ mA}$ ; f = 500 MHz;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ ; typical values.

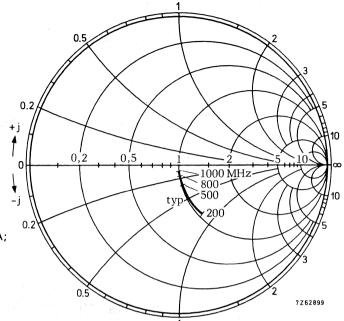


Fig. 12  $V_{CE} = 10 \text{ V}$ ;  $I_{C} = 14 \text{ mA}$ ;  $T_{amb} = 25 \, ^{\circ}\text{C}$ ; typical values.

Input impedance derived from input reflection coefficient sie coordinates in ohm x 50

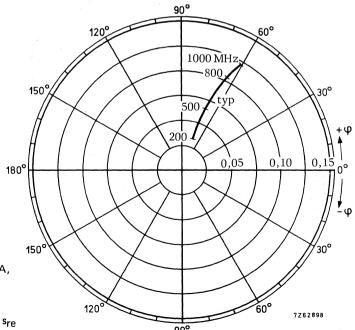
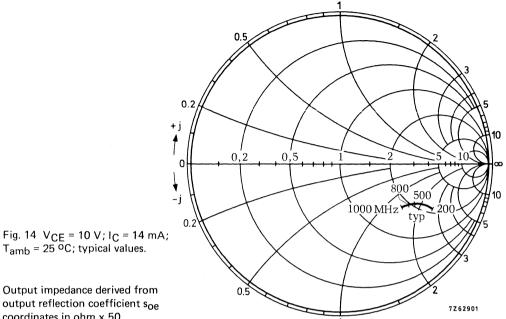


Fig. 13  $V_{CE} = 10 \text{ V}$ ;  $I_{C} = 14 \text{ mA}$ ,  $T_{amb} = 25 \text{ °C}$ ; typical values.

Reverse transmission coefficient sre



Output impedance derived from output reflection coefficient soe coordinates in ohm x 50

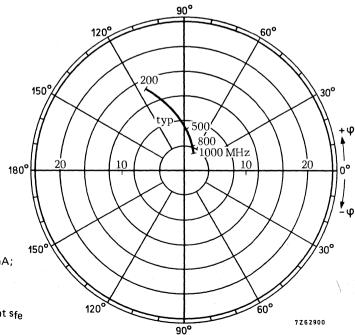


Fig. 15  $V_{CE}$  = 10 V;  $I_{C}$  = 14 mA;  $T_{amb}$  = 25 °C; typical values.

Forward transmission coefficient sfe

# N-P-N 1 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope. It is primarily intended for use in v.h.f./u.h.f. broadband amplifiers. The transistor features:

- low noise;
- low intermodulation distortion;
- high power gain.

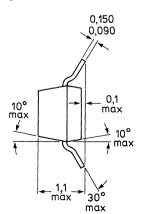
P-N-P complement is BFT92

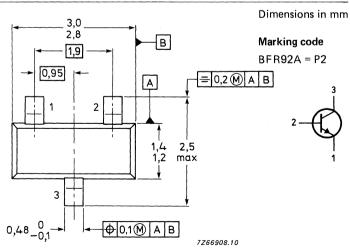
## QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$V_{CBO}$	max.	20	V
Collector-emitter voltage (open-base)	$V_{CEO}$	max.	15	V
Collector current (d.c.)	IC	max.	25	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C	P <sub>tot</sub>	max.	200	mW
Junction temperature	Tj	max.	150	oC
Transition frequency at $f = 500 \text{ MHz}$ $I_C = 14 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	fŢ	typ.	5,0	GHz
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 0$ ; $V_{CE} = 10 \text{ V}$	C <sub>re</sub>	typ.	0,35	pF
Noise figure at R <sub>S</sub> = $60 \Omega$ I <sub>C</sub> = $4 \text{ mA}$ ; V <sub>CE</sub> = $10 \text{ V}$ ; f = $800 \text{ MHz}$	F	typ.	1,8	dB
Output voltage at $d_{im}$ = $-60 \text{ dB}$ $I_C$ = 14 mA; $V_{CE}$ = 10 V; $R_L$ = 75 $\Omega$ $f_{(p+q-r)}$ = 793,25 MHz	Vo	typ.	150	mV

## **MECHANICAL DATA**

Fig. 1 SOT-23.





TOP VIEW

If required, the R-version (reverse pinning) is available on request.

# BFR92A

# RATINGS

na i ings				
Limiting values in accordance with the Absolute Maximum System (IE	C 134)			
Collector-base voltage (open emitter)	VCBO	max.	20	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	15	V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	2,0	V
Collector current (d.c.)	IC	max.	25	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C**	$P_{tot}$	max.	200	mW
Storage temperature	T <sub>stg</sub>	-65 to	+150	oC
Junction temperature	Tj	max.	150	oC
THERMAL RESISTANCE*				
From junction to ambient**	R <sub>th j-a</sub>	=	430	K/W
,	··tir j-a			,
CHARACTERISTICS				
$T_j = 25$ °C unless otherwise specified				
Collector cut-off current			00	
I <sub>E</sub> = 0; V <sub>CB</sub> = 10 V D.C. current gain	ICBO	max.	60	nA
$I_C = 14 \text{ mA}$ ; $V_{CF} = 10 \text{ V}$	hFE	min.	40	
		typ.	90	
Transition frequency at $f = 500 \text{ MHz}$ $I_C = 14 \text{ mA}$ ; $V_{CF} = 10 \text{ V}$	f <sub>T</sub>	typ.	5.0	GHz
Collector capacitance at f = 1 MHz	.1	typ.	0,0	01,12
I <sub>E</sub> = I <sub>e</sub> = 0; V <sub>CB</sub> = 10 V	C <sub>C</sub>	typ.	0,6	pF
Emitter capacitance at f = 1 MHz				
$I_C = I_c = 0$ ; $V_{EB} = 0.5 \text{ V}$	Ce	typ.	1,2	рF
Feedback capacitance at f = 1 MHz	C	<b>.</b>	0.25	~ r
I <sub>C</sub> = 0; V <sub>CE</sub> = 10 V; T <sub>amb</sub> = 25 °C	C <sub>re</sub>	typ.	0,35	рг
Noise figure at $T_{amb}$ = 25 °C $I_{C}$ = 4 mA; $V_{CE}$ = 10 V; $R_{S}$ = 60 $\Omega$ ; f = 800 MHz	F	typ.	1,8	dB
Maximum unilateral power gain (s <sub>re</sub> assumed to be zero)				
$G_{UM} = 10 \log \frac{ s_{fe} ^2}{[1- s_{ie} ^2][1- s_{oe} ^2]}$				
$I_C = 14 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $f = 800 \text{ MHz}$ ; $T_{amb} = 25 ^{\circ}\text{C}$	GUM	typ.	15,5	dB

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

```
Output voltage at d_{im} = -60 \text{ dB} (see Figs 2 and 17)*
    (DIN 45004B, par. 6.3: 3-tone)
    I_C = 14 mA; V_{CE} = 10 V; R_L = 75 \Omega; VSWR < 2; T_{amb} = 25 ^{o}C
   \begin{array}{l} V_p = V_o \text{ at } d_{im} = -60 \text{ dB}; \ f_p = 795,25 \text{ MHz} \\ V_q = V_o - 6 \text{ dB} & ; \ f_q = 803,25 \text{ MHz} \\ V_r = V_o - 6 \text{ dB} & ; \ f_r = 805,25 \text{ MHz} \end{array}
    Measured at f_{(p+q-r)}
                                                  = 793,25 MHz
                                                                                                                       Vo
                                                                                                                                  typ.
                                                                                                                                              150 mV
Second harmonic distortion (see Figs 2 and 18)*
    I_C = 14 mA; V_{CE} = 10 V; R_L = 75 \Omega; VSWR < 2; T_{amb} = 25 ^{\circ}C
   V_p = 60 mV at f_p = 250 MHz

V_q = 60 mV at f_q = 560 MHz
    measured at f_{(p+q)} = 810 \text{ MHz}
                                                                                                                      do
                                                                                                                                             -50 dB
                                                                                                                                  typ.
```

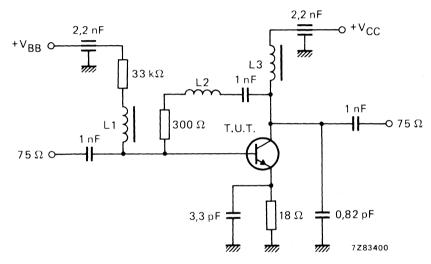


Fig. 2 Intermodulation distortion and second harmonic distortion MATV test circuit.

 $L1 = L3 = 5 \mu H$  micro choke

L2 = 3 turns Cu wire (0,4 mm); internal diameter 3 mm; winding pitch 1 mm

<sup>\*</sup> Measured on same crystal in a SOT-37 envelope (BFR90A).

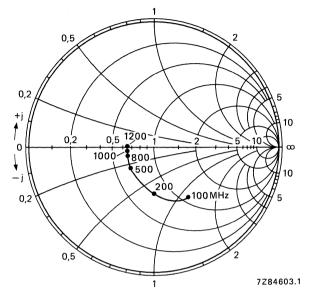


Fig. 3 Input impedance derived from input reflection coefficient  $s_{ie}$  co-ordinates in ohm x 50. VCE = 10 V; IC = 14 mA;  $T_{amb}$  = 25 °C; typical values.

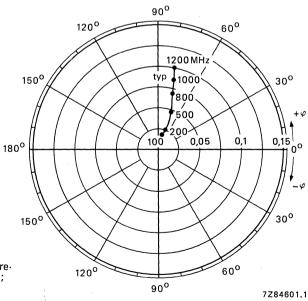


Fig. 4 Reverse transmission coefficient  $s_{re}$ .  $V_{CE}$  = 10 V;  $I_{C}$  = 14 mA;  $T_{amb}$  = 25 °C; typical values.

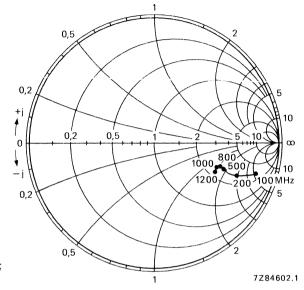


Fig. 5 Output impedance derived from output reflection coefficient soe co-ordinates in ohm x 50.

VCE = 10 V; IC = 14 mA; Tamb = 25 °C; typical values.

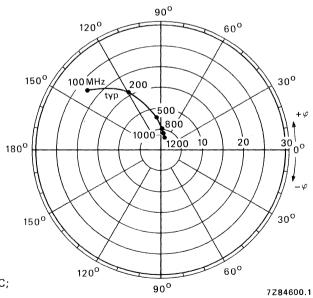


Fig. 6 Forward transmission coefficient sfe.  $V_{CE} = 10 \text{ V}; I_{C} = 14 \text{ mA}; T_{amb} = 25 \text{ °C};$  typical values.

s-parameters (common emitter) at  $V_{CE}$  = 5 V;  $T_{amb}$  = 25 °C; typical values.

I <sub>C</sub> mA	f MHz	s <sub>ie</sub>	s <sub>re</sub>	s <sub>fe</sub>	s <sub>Oe</sub>
2	40	0,88/ -8,9°	0,009/83,6°	6,7/174,2°	1,00/ -2,7°
	100	0,86/ -21,9°	0,022/78,3°	6,5/164,2°	0,98/ -6,6°
	200	0,80/ -42,2°	0,041/69,0°	6,0/149,2°	0,94/-12,2°
	500	0,61/ -87,2°	0,073/54,9°	4,2/119,1°	0,81/-20,2°
	800	0,48/-117,4°	0,086/52,7°	3,1/100,5°	0,74/-22,9°
	1000	0,44/-133,8°	0,092/54,2°	2,6/ 91,4°	0,71/-24,2°
	1200	0,41/-147,6°	0,099/57,5°	2,2/ 84,3°	0,70/-25,7°
5	40	0,75/ -14,4°	0,008/81,8°	14,4/170,2°	0,99/ -4,9°
	100	0,70/ -34,0°	0,020/74,2°	13,3/155,3°	0,94/-11,2°
	200	0,60/ -61,7°	0,034/65,0°	10,9/135,8°	0,84/-17,9°
	500	0,40/-111,1°	0,057/61,1°	6,2/106,9°	0,67/-21,9°
	800	0,32/-139,7°	0,074/65,5°	4,2/ 92,4°	0,62/-22,2°
	1000	0,30/-153,2°	0,086/68,2°	3,4/ 85,3°	0,61/-22,8°
	1200	0,29/-166,2°	0,100/70,9°	2,9/ 79,6°	0,60/-24,0°
10	40	0,61/ -21,1°	0,008/79,7°	22,9/165,2°	0,97/ -7,3°
	100	0,54/ -48,5°	0,017/71,4°	19,8/145,8°	0,88/-15,5°
	200	0,42/ -82,1°	0,028/65,2°	14,4/124,7°	0,74/-20,8°
	500	0,30/-132,3°	0,050/69,0°	7,1/ 99,6°	0,59/-20,5°
	800	0,26/-158,0°	0,072/73,7°	4,7/ 87,8°	0,56/-20,3°
	1000	0,25/-168,3°	0,088/75,2°	3,8/ 82,2°	0,56/-20,9°
	1200	0,25/-179,3°	0,104/76,6°	3,2/ 77,5°	0,55/-22,1°
14	40	0,53/ -26,0°	0,007/78,6°	27,7/162,4°	0,96/ -8,7°
	100	0,45/ -58,1°	0,016/70,5°	22,6/140,7°	0,85/-17,2°
	200	0,36/ -94,4°	0,025/66,6°	15,6/119,7°	0,70/-21,0°
	500	0,27/-142,8°	0,049/72,5°	7,3/ 96,9°	0,57/-19,1°
	800	0,25/-166,0°	0,072/76,5°	4,7/ 86,1°	0,55/-19,1°
	1000	0,24/-174,8°	0,088/77,4°	3,8/ 80,5°	0,55/-19,9°
	1200	0,24/ 174,8°	0,105/78,4°	3,2/ 76,2°	0,54/-21,3°
20	40	0,45/ -33,1°	0,007/77,0°	32,3/158,8°	0,94/-10,1°
	100	0,38/ -71,8°	0,015/69,5°	24,7/135,0°	0,80/-18,4°
	200	0,31/-110,6°	0,023/68,3°	16,0/114,6°	0,66/-20,1°
	500	0,26/-154,5°	0,047/75,5°	7,2/ 94,3°	0,56/-17,3°
	800	0,25/-174,2°	0,071/78,7°	4,7/ 84,3°	0,55/-17,8°
	1000	0,25/ 178,5°	0,088/79,3°	3,7/ 79,1°	0,54/-18,9°
	1200	0,26/ 169,9°	0,104/80,0°	3,2/ 74,9°	0,54/-20,5°

s-parameters (common emitter) at  $V_{CE}$  = 10 V;  $T_{amb}$  = 25 °C; typical values.

I <sub>C</sub>	f MHz	sie	s <sub>re</sub>	s <sub>fe</sub>	s <sub>oe</sub>
2	40	0,89/ -8,7°	0,008/83,6°	6,8/174,4°	1,00/ -2,5°
	100	0,86/ -21,2°	0,021/78,5°	6,5/164,6°	0,98/ -6,1°
	200	0,80/ -40,9°	0,038/69,5°	6,0/149,6°	0,94/-11,3°
	500	0,61/ -85,3°	0,069/55,8°	4,3/119,8°	0,82/-18,7°
	800	0,48/-115,4°	0,081/53,8°	3,1/101,2°	0,75/-21,3°
	1000	0,44/-131,4°	0,086/55,5°	2,6/ 92,1°	0,73/-22,5°
	1200	0,40/-145,6°	0,093/58,9°	2,2/ 85,0°	0,72/-23,9°
5	40 100 200 500 800 1000 1200	0,77/ -13,6° 0,73/ -32,3° 0,62/ -58,8° 0,41/-107,2° 0,32/-135,9° 0,30/-150,0° 0,28/-162,9°	0,008/81,8° 0,019/74,7° 0,032/65,6° 0,054/61,4° 0,071/65,9° 0,082/68,6° 0,095/71,5°	14,2/170,5° 13,2/155,8° 11,0/136,8° 6,3/107,7° 4,2/ 92,9° 3,5/ 86,1° 2,9/ 80,5°	0,99/ -4,5° 0,95/-10,3° 0,85/-16,6° 0,69/-20,4° 0,64/-20,8° 0,63/-21,3° 0,62/-22,4°
	40	0,66/ -19,4°	0,007/80,1 <sup>0</sup>	22,5/165,9°	0,97/ -6,6°
	100	0,58/ -44,7°	0,017/71,8 <sup>0</sup>	19,5/147,0°	0,90/-14,1°
	200	0,45/ -76,2°	0,027/65,4 <sup>0</sup>	14,5/126,0°	0,76/-19,3°
10	500	0,29/—125,1°	0,049/68,7 <sup>0</sup>	7,2/100,6°	0,62/—19,2°
	800	0,24/—151,8°	0,070/73,5 <sup>0</sup>	4,7/ 88,8°	0,59/—19,0°
	1000	0,24/—162,9°	0,084/75,2 <sup>0</sup>	3,8/ 82,6°	0,58/—19,7°
	1200	0,23/-174,8 <sup>0</sup>	0,099/76,8 <sup>0</sup>	3,2/ 78,3 <sup>o</sup>	0,58/—20,9 <sup>0</sup>
	40	0,60/ -23,2 <sup>0</sup>	0,007/78,6 <sup>0</sup>	27,2/163,0 <sup>o</sup>	0,96/ —7,9 <sup>0</sup>
14	100	0,51/ -52,5°	0,016/70,6°	22,6/141,8°	0,86/—15,8°
	200	0,38/ -86,2°	0,025/66,4°	15,7/120,7°	0,72/—19,6°
	500	0,26/-134,3°	0,047/72,0°	7,5/ 97,8°	0,60/—18,0°
	800	0,22/-159,3°	0,069/76,2°	4,8/ 86,8°	0,57/—18,0°
	1000	0,22/-169,0°	0,085/77,3°	3,9/ 81,3°	0,57/—18,7°
	1200	0,22/ 179,8°	0,100/78,5°	3,3/ 76,8°	0,57/—20,1°
	40	0,54/ -28,2°	0,007/77,4 <sup>0</sup>	31,7/159,9°	0,95/ -9,1°
	100	0,45/ -61,7°	0,015/69,5 <sup>0</sup>	24,7/136,8°	0,82/-16,8°
20	200	0,33/ -97,5°	0,023/67,5°	16,3/116,2°	0,68/—18,8°
	500	0,24/-143,7°	0,046/74,4°	7,4/ 95,3°	0,59/—16,4°
	800	0,22/-166,4°	0,069/78,0°	4,8/ 85,2°	0,57/—16,9°
	1000	0,22/-174,7°	0,084/78,7°	3,8/ 80,1°	0,57/—17,8°
	1200	0,22/ 176,3°	0,100/79,7°	3,3/ 76,0°	0,57/—19,4°
	1	1		1	I .

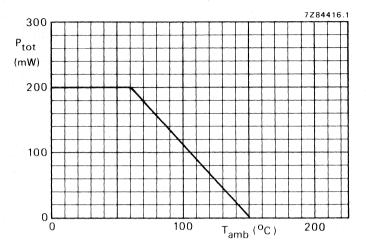


Fig. 7 Power derating curve.

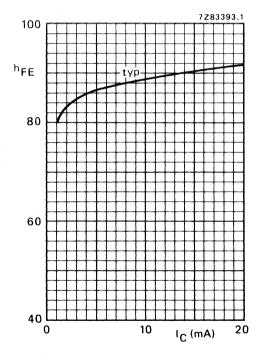


Fig. 8  $V_{CE} = 10 \text{ V}$ ;  $T_j = 25 \text{ °C}$ ; typical values.

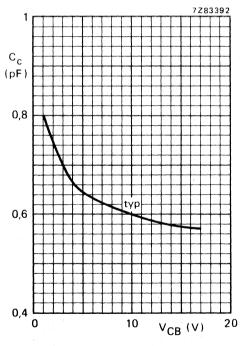


Fig. 9  $I_E = I_e = 0$ ; f = 1 MHz;  $T_j = 25 \text{ °C}$ ; typical values.

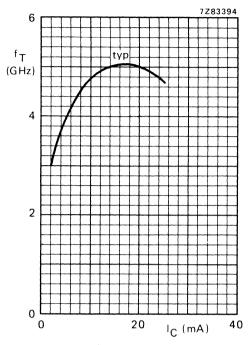


Fig. 10  $V_{CE}$  = 10 V; f = 500 MHz;  $T_j$  = 25 °C; typical values.

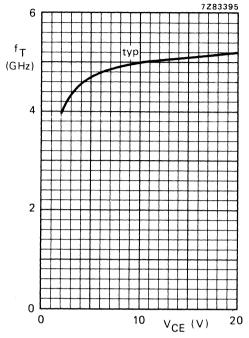


Fig. 11  $I_C = 14 \text{ mA}$ ; f = 500 MHz;  $T_j = 25 \text{ °C}$ ; typical values.

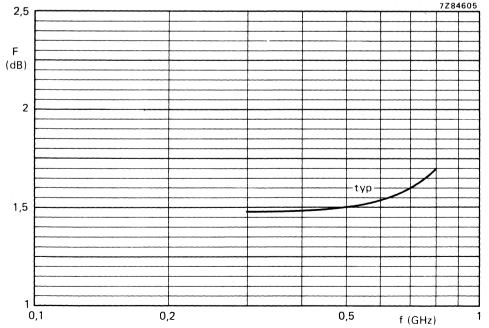


Fig. 12  $V_{CE} = 10 V$ ;  $I_{C} = 4 \text{ mA}$ ;  $Z_{S} = \text{optimum}$ ;  $T_{amb} = 25 \text{ oC}$ ; typical values.

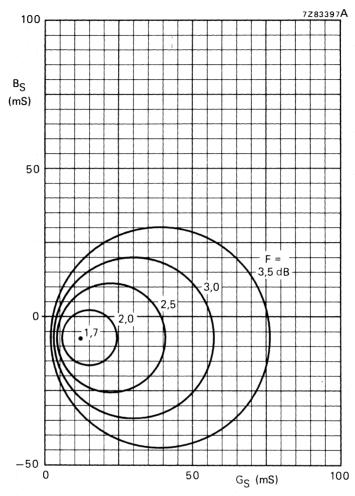


Fig. 13 Circles of constant noise figure.  $V_{CE}$  = 10 V;  $I_{C}$  = 4 mA; f = 800 MHz;  $T_{amb}$  = 25 °C; typical values.

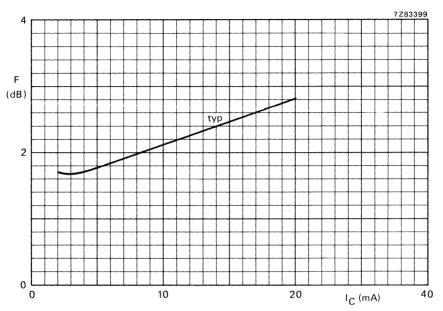


Fig. 14  $V_{CE}$  = 10 V; f = 800 MHz;  $Z_{S}$  = optimum;  $T_{amb}$  = 25 °C; typical values.

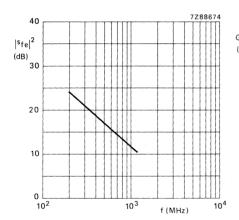


Fig. 15  $V_{CE}$  = 10 V;  $I_{C}$  = 14 mA;  $T_{amb}$  = 25 °C; typical values.

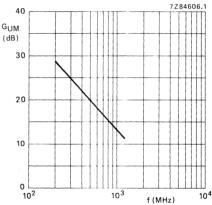


Fig. 16  $V_{CE}$  = 10 V; I<sub>C</sub> = 14 mA;  $T_{amb}$  = 25 °C; typical values.

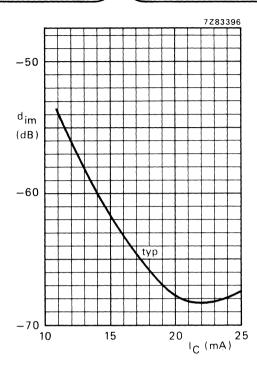


Fig. 17 V<sub>CE</sub> = 10 V; V<sub>O</sub> = 43,5 dBmV = 150 mV;  $f_{(p+q-r)}$  = 793,25 MHz;  $T_{amb}$  = 25 °C; measured in MATV test circuit (see Fig. 2); typical values.

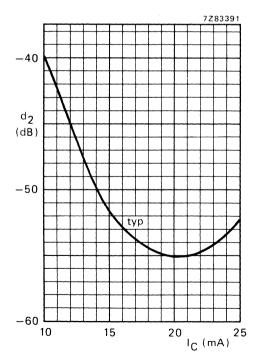


Fig. 18  $V_{CE}$  = 10 V;  $V_{o}$  = 60 mV;  $f_{(p+q)}$  = 810 MHz;  $T_{amb}$  = 25 °C; measured in MATV test circuit (see Fig. 2); typical values.

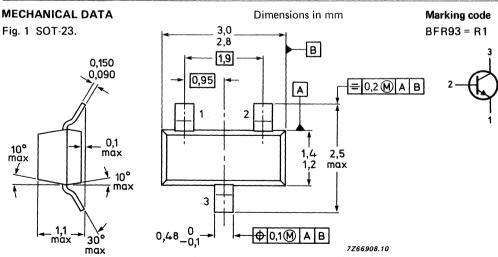
# N-P-N 1 GHz WIDEBAND TRANSISTOR

N-P-N transistor in a SOT-23 plastic envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers etc. The transistor features very low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

P-N-P complement is the BFT93.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	15	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	12	V
Collector current (d.c.)	IC	max.	35	mΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.	200	mW
Junction temperature	$T_{j}$	max.	150	oC
Transition frequency at $f = 500 \text{ MHz}$ $I_C = 30 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	fΤ	typ.	5	GHz
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	C <sub>re</sub>	typ.	0,8	pF
Noise figure at optimum source impedance $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 500 \text{ MHz}$ ;	F	typ.	1,9	dB
Max. unilateral power gain $I_C = 30 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 500 \text{ MHz}$ ;	GUM	typ.	16,5	dB
Intermodulation distortion at $T_{amb}$ = 25 $^{o}C$ $I_{C}$ = 30 mA; $V_{CE}$ = 5 V; $R_{L}$ = 75 $\Omega$ ; $V_{o}$ = 300 mV $f_{(p+q-r)}$ = 493,25 MHz	d <sub>im</sub>	typ.	60	dB



TOP VIEW If required, the R-version (reverse pinning) is available on request.

## **RATINGS**

HATINGS					
Limiting values in accordance with the Al	bsolute Maximum Syste	m (IEC 134)			
Collector-base voltage (open emitter)		V <sub>CBO</sub>	max.	15	V , ,
Collector-emitter voltage (open base)		V <sub>CEO</sub>	max.	12	٧
Emitter-base voltage (open collector)		V <sub>EBO</sub>	max.	2,0	V
Collector current (d.c.)		IC	max.	35	mA
Total power dissipation up to $T_{amb} = 60$	oC**	P <sub>tot</sub>	max.	200	mW
Storage temperature		$T_{stg}$	-65 to	+ 150	oC
Junction temperature		τ <sub>j</sub>	max.	150	оС
THERMAL CHARACTERISTICS *					
$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{an}$	nb				
Thermal resistance					
From junction to tab		R <sub>th j-t</sub>	=	60	K/W
From tab to soldering points		R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient **		R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS					
T <sub>j</sub> = 25 °C unless otherwise specified					
Collector cut-off current					
I <sub>E</sub> = 0; V <sub>CB</sub> = 10 V		СВО	max.	50	nΑ
D.C. current gain A IC = 30 mA; VCE = 5 V		hee	min.	25	
1C = 30 mA, VCE = 5 V		hFE	typ.	50	
Transition frequency at f = 500 MHz		•	du en	_	GHz
$I_C = 30 \text{ mA}; V_{CE} = 5 \text{ V}$		fT	typ.	5	GHZ
Collector capacitance at f = 1 MHz I <sub>E</sub> = I <sub>e</sub> = 0; V <sub>CB</sub> = 10 V		C <sub>c</sub>	typ.	0,7	pF
Emitter capacitance at f = 1 MHz		-0	-/	-,-	•
$I_C = I_C = 0$ ; $V_{EB} = 0.5 \text{ V}$		C <sub>e</sub>	typ.	1,8	рF
Feedback capacitance at f = 1 MHz		: - <del>-</del>			
$I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}; T_{amb} = 25 \text{ oC}$		C <sub>re</sub>	typ.	0,8	рF

<sup>▲</sup> Measured under pulse conditions. \* See *Thermal characteristics*.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

1.9 dB

Noise figure at optimum source impedance \* F  $I_C = 2 \text{ mA}$ ;  $V_{CF} = 5 \text{ V}$ ; f = 500 MHz;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ typ.

Max. unilateral power gain (sre assumed to be zero)

$$G_{UM} = 10 \log \frac{|s_{fe}|^2}{(1 - |s_{ie}|^2) (1 - |s_{Oe}|^2)}$$

 $I_C = 30 \text{ mA}$ ;  $V_{CE} = 5 \text{ V}$ ; f = 500 MHz;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ 16,5 dB **GUM** typ.

Intermodulation distortion at Tamb = 25 °C \*

$$I_C$$
 = 30 mA;  $V_{CF}$  = 5 V;  $R_1$  = 75 Ω; V.S.W.R. < 2

 $\begin{array}{l} {\rm V_p = V_o = 300\;mV\;at\;f_p = 495,25\;MHz} \\ {\rm V_q = V_o - 6\;dB} & {\rm at\;f_q = 503,25\;MHz} \\ {\rm V_r = V_o - 6\;dB} & {\rm at\;f_r = 505,25\;MHz} \\ \end{array}$ 

Measured at  $f_{(p+q-r)} = 493,25 \text{ MHz}$ 

-60 dB  $d_{im}$ typ.

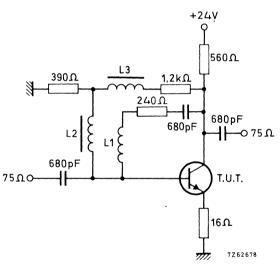


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35); winding pitch 1 mm; int. dia. 4 mm L2 and L3 5 µH (code number: 3122 108 20150)

<sup>\*</sup> Crystal mounted in a BFR91 envelope.

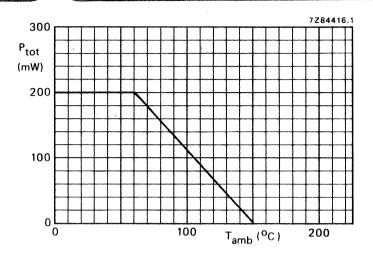
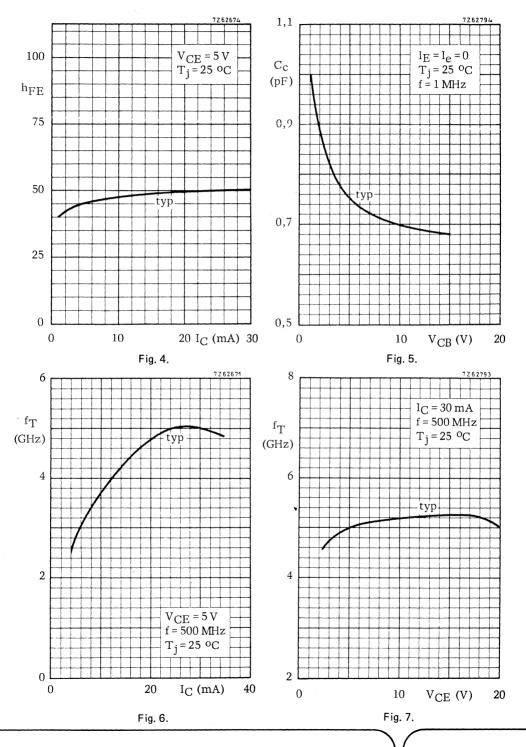
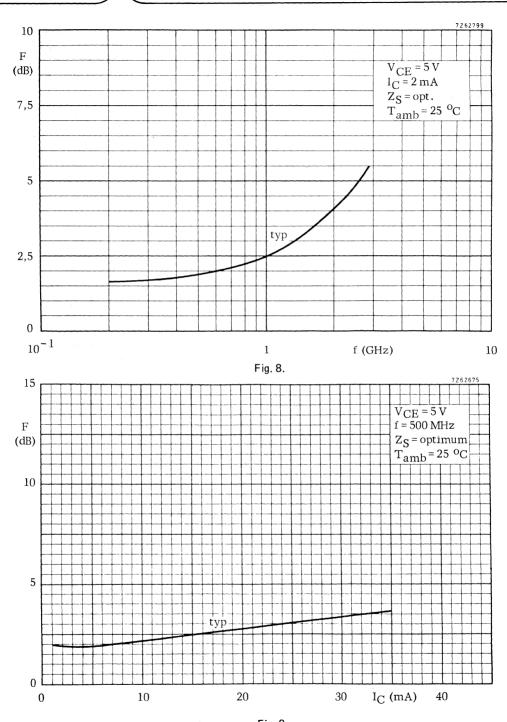
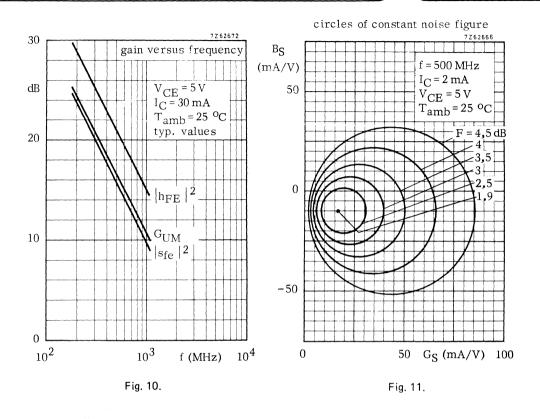


Fig. 3 Power derating curve.







 $V_{CE} = 5 V$   $I_{C} = 30 \text{ mA}$   $T_{amb} = 25 \, {}^{o}\text{C}$ 

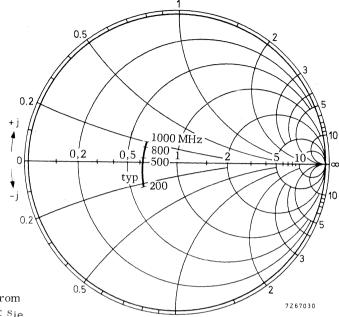
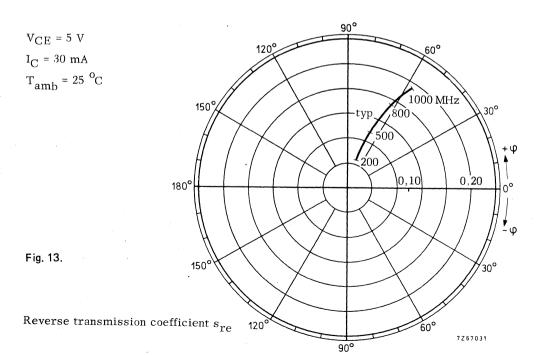


Fig. 12.

Input impedance derived from input reflection coefficient  $s_{ie}$  coordinates in ohm x 50



 $V_{CE} = 5 \text{ V}$   $I_{C} = 30 \text{ mA}$   $T_{amb} = 25 \, ^{\text{o}}\text{C}$ 

Fig. 14.

0.2 0.2 0.2 0.2 0.2 0.5 1000 MHz 1000 M

Output impedance derived from output reflection coefficient  $s_{\text{OC}}$  coordinates in ohm x  $50\,$ 

 $V_{CE} = 5 V$   $I_{C} = 30 \text{ mA}$   $T_{amb} = 25 \, {}^{o}\text{C}$ 

 $\frac{200 \text{ MHz}}{180^{\circ}}$   $\frac{200 \text{ MHz}}{1000}$   $\frac{800}{1000}$   $\frac{10}{1000}$   $\frac{20}{1000}$   $\frac{10}{1000}$   $\frac{10}{$ 

90°

120°

Fig. 15.

Forward transmission coefficient  $\mathbf{s}_{\mbox{\scriptsize fe}}$ 

### N-P-N 1 GHz WIDEBAND TRANSISTOR

N-P-N transistors in a SOT-23 plastic envelope. They are primarily intended for use in v.h.f./u.h.f. broadband amplifiers. The transistors feature:

- low noise:
- very low intermodulation distortion;
- high power gain;
- P-N-P complement to the BFR93

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$v_{CBO}$	max.	15 V
Collector-emitter voltage (open base)	VCEO	max.	12 V
Collector current (d.c.)	lc	max.	35 mA
Total power dissipation up to T <sub>amb</sub> = 45 °C	P <sub>tot</sub>	max.	250 mW
Junction temperature	Ti	max.	150 °C
Transition frequency at $f = 500 \text{ MHz}$ I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 5 V	fΤ	typ.	5 GHz
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 0$ ; $V_{CE} = 5 \text{ V}$ ; $T_{amb} = 25 ^{\circ}\text{C}$	C <sub>re</sub>	typ.	0,6 pF
Noise figure at optimum source impedance $I_C = 4 \text{ mA}$ ; $V_{CE} = 8 \text{ V}$ ; $f = 800 \text{ MHz}$	F	typ.	1,6 dB
Output voltage at $d_{im}$ = $-60 \text{ dB}$ I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 8 V; R <sub>L</sub> = 75 $\Omega$ ; T <sub>amb</sub> = 25 °C			
$f_{(p+q-r)} = 793,25 \text{ MHz}$	$V_{o}$	typ.	425 mV

#### **MECHANICAL DATA** Dimensions in mm Marking code Fig. 1 SOT-23. 3,0 BFR93A = R22,8 В 1,9 0,150 0,090 0,95 0,2 (M) A B Α 2 0,1 10° max 2,5 max max ₹ 10° ∡ max 3 \_1,1 \_max **⊕** 0,1(M) A B 30° 7266908.10 max

TOP VIEW

If required, the R-version (reverse pinning) is available on request See also *Soldering recommendations*.

RATINGS				
Limiting values in accordance with the Absolu	te Maximum System (IEC 134)			
Collector-base voltage (open emitter)	$V_{CBO}$	max.	15	V
Collector-emitter voltage (open base)	V <sub>CEO</sub>	max.	12	V
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.	2,0	V
Collector current (d.c.)	l <sub>C</sub>	max.	35	mΑ
Total power dissipation up to Tamb = 45 °C**	* P <sub>tot</sub>	max.	250	mW
Storage temperature	$T_{sta}$	65 to	+ 150	оС
Junction temperature	$T_{j}$	max.	150	oC
THERMAL CHARACTERISTICS*				
$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	=	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	Manual Traum	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	STATEMENT AND ADDRESS OF THE ADDRESS	90	K/W
CHARACTERISTICS				
$T_j = 25$ °C unless otherwise specified				
Collector cut-off current I <sub>E</sub> = 0; V <sub>CB</sub> = 5 V	<sup>I</sup> CBO	max.	50	nA
D.C. current gain▲ I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 5 V	hFE	min. typ.	40 90	
Transition frequency at f = 500 MHz▲ IC = 30 mA; VCE = 5 V	fΤ	typ.		GHz
Collector capacitance at $f = 1$ MHz $I_E = I_e = 0$ ; $V_{CB} = 5$ V	$C_{\mathbf{c}}$	typ.	0,7	pF
Emitter capacitance at $f = 1 \text{ MHz}$ $I_C = I_c = 0$ ; $V_{EB} = 0.5 \text{ V}$	$C_{e}$	typ.	1,9	pF
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 0$ ; $V_{CE} = 5 \text{ V}$ ; $T_{amb} = 25 \text{ °C}$	$c_{re}$	typ.	0,6	pF
Noise figure at optimum source impedance▲  I <sub>C</sub> = 4 mA; V <sub>CE</sub> = 8 V; f = 800 MHz  I <sub>C</sub> = 30 mA; V <sub>CE</sub> = 8 V; f = 800 MHz	F	typ. typ.	1,6 2,3	
Maximum unilateral power gain (s <sub>re</sub> assumed t See Figs 10 to 15	to be zero)			
$G_{UM}$ (in dB) = 10 log $\frac{ s_{fe} ^2}{(1 -  s_{ie} ^2)(1 -  s_{oe} ^2)}$	<sup>2</sup> )			
$I_C$ = 30 mA; $V_{CE}$ = 8 V; f = 800 MHz; $T_{am}$	$_{\rm b}$ = 25 °C G <sub>UM</sub>	typ.	14	dB

- Measured under pulse conditions.
- See Thermal characteristics.
- \*\* Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.

```
Output voltage at dim = -60 dB (see Figs 2 and 16)*
   (DIN 45004B, par. 6.3: 3-tone)
   I_C = 30 \text{ mA}; V_{CE} = 8 \text{ V}; R_L = 75 \Omega; T_{amb} = 25 \text{ }^{\circ}\text{C}
   V_p = V_o at d_{im} = -60 dB; f_p = 795,25 MHz
   V_q = V_o - 6 dB

V_r = V_o - 6 dB
                                       ; f_q = 803,25 \text{ MHz}
; f_r = 805,25 \text{ MHz}
   Measured at f(p+q--r)
                                             = 793,25 MHz
                                                                                                           ٧<sub>0</sub>
                                                                                                                                 425 mV
Second harmonic distortion (see Figs 2 and 17)*
   I_C = 30 \text{ mA}; V_{CE} = 8 \text{ V}; R_L = 75 \Omega; T_{amb} = 25 \text{ °C}
   V_p = 200 mV at f_p = 250 MHz

V_q = 200 mV at f_q = 560 MHz
   measured at f_{(p+q)} = 810 \text{ MHz}
                                                                                                           d_2
                                                                                                                                  -50 dB
```

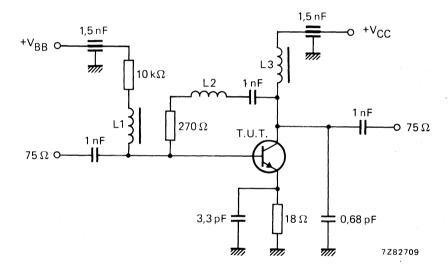


Fig. 2 Intermodulation distortion and second harmonic distortion MATV test circuit.

L1 = L3 = 5  $\mu$ H micro choke L2 = 3 turns Cu wire (0,4 mm); internal diameter 3 mm; winding pitch 1 mm.

<sup>\*</sup> Measured on same crystal in a SOT-37 envelope (BFR91A).

### s-parameters (common emitter)

V <sub>CE</sub> V	I <sub>C</sub>	f MHz	s <sub>ie</sub>	s <sub>re</sub>	s <sub>fe</sub>	s <sub>oe</sub>
5	2	40 100 200 500 800 1000 1200	0,89/ -12,4° 0,87/ -30,1° 0,80/ -56,3° 0,64/-109,5° 0,57/-140,3° 0,54/-154,5° 0,53/-166,6°	0,016/82,3° 0,038/74,2° 0,067/61,8° 0,106/44,3° 0,116/41,8° 0,119/43,9° 0,124/48,2°	7,0/171,8° 6,7/160,1° 6,0/142,3° 3,8/110,6° 2,7/ 91,5° 2,2/ 82,8° 1,9/ 75,1°	0,88/ -4,8° 0,96/-11,3° 0,88/-20,1° 0,69/-31,9° 0,60/-35,5° 0,58/-38,0° 0,56/-40,2°
5	5	40 100 200 500 800 1000 1200	0,77/ -19,9° 0,72/ -46,9° 0,62/ -81,4° 0,48/-134,4° 0,45/-159,8° 0,44/-170,8° 0,43/ 179,8°	0,015/79,4° 0,033/68,6° 0,053/57,0° 0,079/52,6° 0,099/57,8° 0,114/61,0° 0,131/64,2°	15,1/166,8° 13,5/149,7° 10,5/128,5° 5,5/100,5° 3,6/ 85,6° 3,0/ 78,8° 2,5/ 72,9°	0,97/ -8,8° 0,89/-19,6° 0,73/-30,3° 0,51/-37,3° 0,44/-37,9° 0,42/-39,3° 0,41/-40,9°
5	10	40 100 200 500 800 1000 1200	0,63/ -29,7° 0,56/ -66,2° 0,47/-105,4° 0,41/-152,0° 0,39/-171,7° 0,39/ 179,6° 0,39/ 171,6°	0,013/76,5° 0,028/64,8° 0,042/57,8° 0,070/62,6° 0,099/67,6° 0,119/69,1° 0,140/70,5°	24,4/161,0° 20,0/139,4° 13,6/118,0° 6,4/ 94,8° 4,1/ 82,7° 3,4/ 76,7° 2,8/ 71,5°	0,95/—13,5° 0,80/—17,8° 0,59/—37,3° 0,39/—39,0° 0,35/—38,2° 0,34/—39,1° 0,33/—40,7°
5	20	40 100 200 500 800 1000 1200	0,47/ -44,2° 0,42/ -90,7° 0,39/-129,4° 0,37/-165,1° 0,37/ 179,5° 0,36/ 173,0° 0,37/ 166,2°	0,012/73,8° 0,023/63,9° 0,034/62,9° 0,067/70,5° 0,101/73,2° 0,124/73,4° 0,148/73,6°	35,2/154,0° 25,4/129,3° 15,6/109,7° 6,8/ 90,9° 4,4/ 80,3° 3,6/ 75,4° 3,0/ 70,3°	0,90/-19,2° 0,68/-35,0° 0,47/-41,0° 0,32/-38,4° 0,29/-37,4° 0,29/-38,3° 0,28/-40,0°
5	30	40 100 200 500 800 1000 1200	0,39/ -56,3° 0,38/-106,8° 0,37/-141,6° 0,37/-171,0° 0,37/ 175,9° 0,36/ 170,0° 0,37/ 163,9°	0,011/72,3° 0,021/64,5° 0,032/66,4° 0,067/73,5° 0,102/75,2° 0,126/74,8° 0,150/74,6°	40,8/149,5° 27,4/124,0° 16,0/105,8° 6,9/ 88,9° 4,4/ 79,1° 3,6/ 74,2° 3,0/ 69,5°	0,86/-22,5° 0,61/-37,9° 0,41/-41,1° 0,29/-36,6° 0,27/-36,0° 0,27/-37,1° 0,27/-39,0°

### s-parameters (common emitter)

V <sub>CE</sub> V	I <sub>C</sub>	f MHz	s <sub>ie</sub>	s <sub>re</sub>	sfe	s <sub>oe</sub>
8	2	40 100 200 500 800 1000 1200	0,90/ -12,2° 0,88/ -29,2° 0,81/ -54,7° 0,64/-107,0° 0,56/-138,1° 0,54/-152,6° 0,52/-165,2°	0,015/82,1° 0,036/74,5° 0,064/62,4° 0,103/44,9° 0,112/42,1° 0,116/44,1° 0,120/48,5°	6,9/171,7° 6,6/160,4° 5,9/143,1° 3,8/111,5° 2,7/ 92,2° 2,3/ 83,6° 1,9/ 75,9°	0,99/ -4,8° 0,96/-10,8° 0,89/-19,2° 0,71/-30,6° 0,62/-34,1° 0,60/-36,4° 0,58/-38,6°
8	5	40 100 200 500 800 1000 1200	0,78/ -19,2° 0,73/ -44,6° 0,63/ -78,1° 0,48/-131,2° 0,44/-157,3° 0,42/-168,3° 0,42/-178,3°	0,014/79,4° 0,032/69,0° 0,051/57,5° 0,077/52,5° 0,096/57,7° 0,110/61,0° 0,126/64,3°	14,8/166,9° 13,5/150,4° 10,5/129,4° 5,6/101,3° 3,7/ 86,3° 3,0/ 79,5° 2,6/ 73,6°	0,98/ -8,6° 0,90/-18,7° 0,75/-28,9° 0,53/-35,7° 0,46/-36,2° 0,44/-37,5° 0,43/-39,0°
8	10	40 100 200 500 800 1000 1200	0,66/ -27,7° 0,58/ -62,0° 0,48/-100,1° 0,40/-148,2° 0,38/-169,1° 0,37/-178,3° 0,37/ 173,6°	0,013/76,7° 0,027/65,4° 0,041/58,0° 0,068/62,2° 0,096/67,4° 0,116/69,0° 0,136/70,5°	24,0/161,5° 19,9/140,4° 13,8/119,0° 6,5/ 95,4° 4,2/ 83,0° 3,4/ 77,4° 2,9/ 72,5°	0,95/-12,90 0,81/-26,30 0,61/-35,50 0,42/-37,00 0,37/-36,20 0,36/-37,00 0,35/-38,50
8	20	40 100 200 500 800 1000 1200	0,53/ -39,6° 0,45/ -83,0° 0,39/-122,0° 0,35/-161,3° 0,35/-177,9° 0,34/ 175,2° 0,34/ 168,3°	0,012/73,8° 0,023/63,9° 0,034/62,2° 0,066/69,7° 0,098/72,7° 0,121/73,1° 0,143/73,4°	34,7/154,8° 25,6/130,5° 15,9/110,6° 7,0/ 91,4° 4,5/ 80,7° 3,7/ 75,8° 3,1/ 71,2°	0,91/-18,1° 0,70/-33,2° 0,49/-39,0° 0,34/-36,2° 0,31/-35,1° 0,31/-36,0° 0,30/-37,5°
8	30	40 100 200 500 800 1000 1200	0,47/ -48,0° 0,41/ -95,5° 0,36/-132,8° 0,35/-166,6° 0,34/ 178,8° 0,34/ 172,7° 0,34/ 166,0°	0,011/72,2° 0,021/63,8° 0,032/64,9° 0,065/72,3° 0,100/74,4° 0,122/74,4° 0,145/74,3°	40,3/150,8° 27,5/125,4° 16,4/106,8° 7,1/ 89,6° 4,5/ 79,7° 3,7/ 74,7° 3,1/ 70,3°	0,87/-20,9° 0,63/-35,7° 0,44/-38,9° 0,32/-34,4° 0,30/-33,6° 0,30/-34,7° 0,29/-36,5°

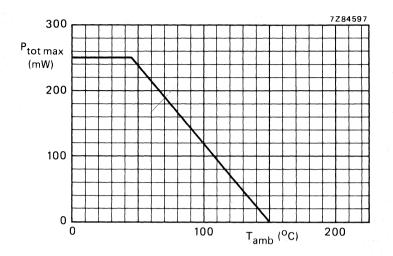


Fig. 3 Power derating curve.

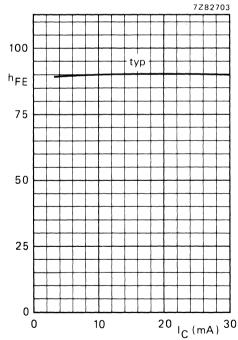


Fig. 4  $V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \text{ °C}$ .

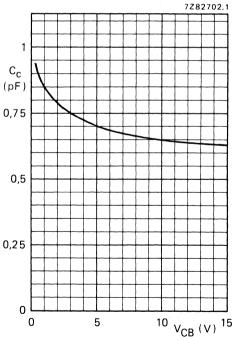


Fig. 5 Typical values collector capacitance  $\rm I_E = \rm I_e = 0; \ f = 1 \ MHz; \ T_j = 25 \ ^{o}C.$ 

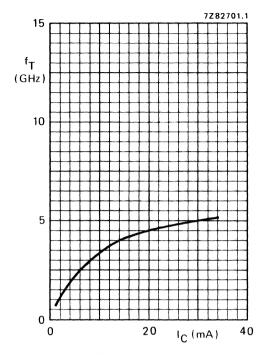


Fig. 6 Typical values transition frequency at  $V_{CE}$  = 5 V; f = 500 MHz;  $T_j$  = 25 °C.

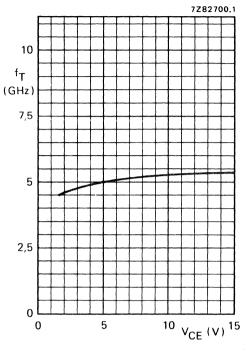


Fig. 7 Typical values transition frequency at  $I_C = 30$  mA; f = 500 MHz;  $T_i = 25$  °C.

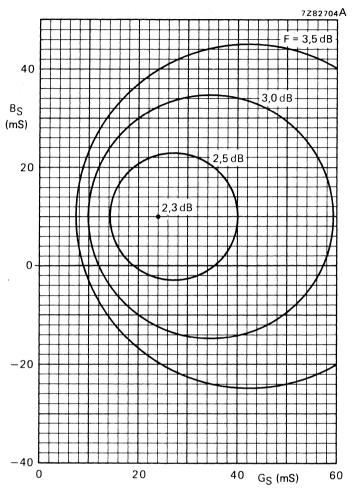


Fig. 8 Circles of constant noise figure.  $V_{CE}$  = 8 V;  $I_{C}$  = 30 mA; f = 800 MHz;  $T_{amb}$  = 25 °C; typical values.

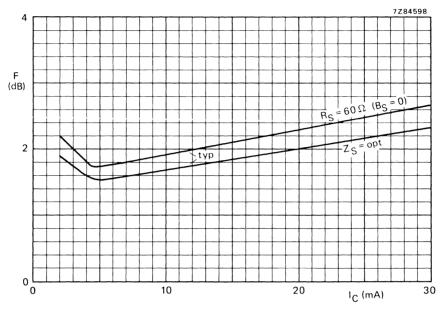


Fig. 9  $V_{CE} = 8 \text{ V}$ ; f = 800 MHz;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ .

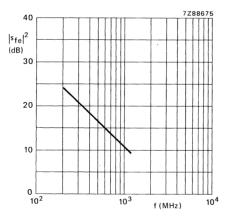


Fig. 10 Typical values forward transmission coefficient as a function of frequency.  $V_{CE}$  = 8 V;  $I_{C}$  = 30 mA;  $T_{amb}$  = 25  $^{o}C$ .

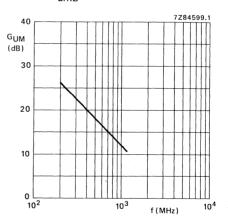


Fig. 11 Typical values unilateral power power gain as a function of frequency.  $V_{CE} = 8 \text{ V}$ ;  $I_{C} = 30 \text{ mA}$ ;  $T_{amb} = 25 ^{\circ}\text{C}$ .

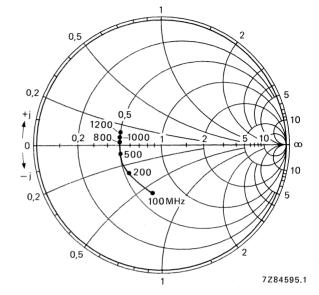


Fig. 12 Input impedance derived from input reflection coefficient  $s_{ie}$  co-ordinates in ohm x 50.  $V_{CE} = 8 \text{ V}$ ;  $I_C = 30 \text{ mA}$ ;  $T_{amb} = 25 \text{ °C}$ .

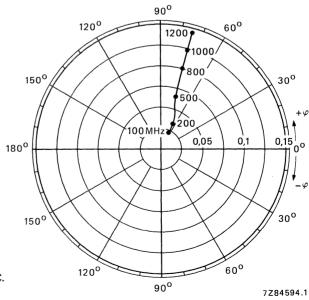


Fig. 13 Reverse transmission coefficient  $s_{re}$ .  $V_{CE}$  = 8 V;  $I_{C}$  = 30 mA;  $T_{amb}$  = 25 °C.

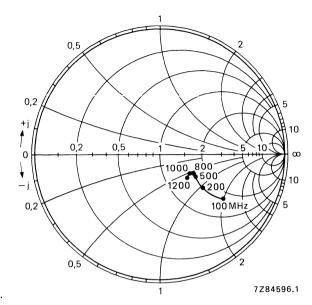


Fig. 14 Output impedance derived from output reflection coefficient  $s_{Oe}$  co-ordinates in ohm x 50.  $V_{CE}$  = 8 V;  $I_{C}$  = 30 mA;  $T_{amb}$  = 25 °C.

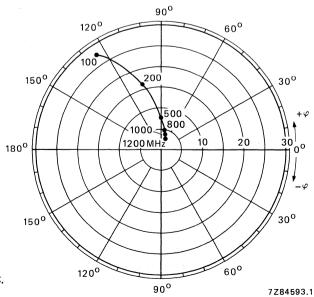


Fig. 15 Forward transmission coefficient  $s_{fe}$ .  $V_{CE}$  = 8 V;  $I_{C}$  = 30 mA;  $T_{amb}$  = 25 °C.

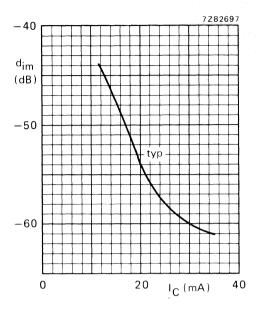


Fig. 16  $V_{CE}$  = 8 V;  $V_{o}$  = 425 mV = 52,6 dBmV;  $f_{(p+q-r)}$  = 793,25 MHz;  $T_{amb}$  = 25 °C; measured in MATV test circuit (see Fig. 2).

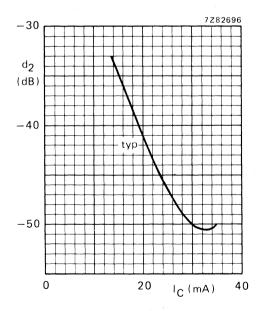


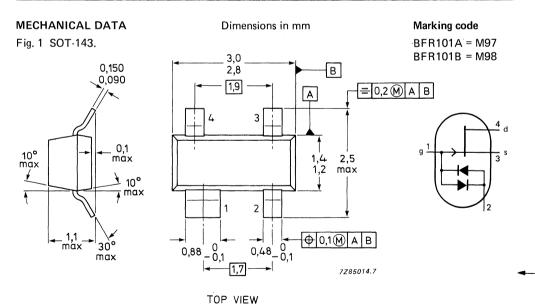
Fig. 17  $V_{CE}$  = 8 V;  $V_{O}$  = 200 mV = 46 dBmV;  $f_{(p+q)}$  = 810 MHz;  $T_{amb}$  = 25 °C; measured in MATV test circuit (see Fig. 2).

### N-CHANNEL JUNCTION FIELD-EFFECT TRANSISTOR

Symmetrical n-channel silicon junction field-effect transistor, designed primarily for use as a source follower with the input protected against successive voltage surges by a forward and reverse integrated diode.

#### QUICK REFERENCE DATA

Drain-source voltage	± V <sub>DS</sub>	max.	30 V
Gate-source voltage (open drain)	$-V_GS$	max.	30 V
Total power dissipation up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.	200 mW
Drain current			
$V_{DS} = 6 V; V_{GS} = 0: BFR101A$	IDSS	0,2 t	o 1,5 mA
$V_{DS} = 6 \text{ V}; V_{GS} = 0: BFR101B$	1 <sub>DSS</sub>	1,0 t	o 5,0 mA
Transfer admittance (common source)			
$V_{DS} = 6 \text{ V}; V_{GS} = 0; f = 1 \text{ kHz}: BFR101A$	yfs	>	1,2 mS
$V_{DS} = 6 \text{ V; } V_{GS} = 0; f = 1 \text{ kHz: BFR101B}$	y <sub>fs</sub>	>	2,5 mS



See also Soldering recommendations.

## BFR101A BFR101B

### **RATINGS**

Limiting values in accordance with the Absolute N	laximum System (IEC	134)	
Drain-source voltage	± V <sub>DS</sub>	max.	30 V
Drain-gate voltage (open source)	$V_{DGO}$	max.	30 V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30 V
Drain current (d.c.)	I <sub>D</sub>	max.	20 mA
Gate current (d.c.)	IG	max.	10 mA
Total power dissipation up to T <sub>amb</sub> = 60 °C*	$P_{tot}$	max.	200 mW
Storage temperature	$T_{stg}$	−65 to	+ 150 °C
Junction temperature	Тj	max.	150 °C
THERMAL RESISTANCE			

R<sub>th j-a</sub>

460 K/W

### CHARACTERISTICS with source connected to case for all measurements

T<sub>amb</sub> = 25 °C unless otherwise specified

From junction to ambient in free air\*

ams .			
Gate leakage current		BFR101A	BFR101B
$V_{DS} = 6 \text{ V}; I_D = 10 \mu \text{A}$	I <sub>G</sub>	< 5	5 nA
Drain current*			
$V_{DS} = 6 V; V_{GS} = 0$	IDSS	0,2 to 1,5	1 to 5 mA
Gate-source cut-off voltage			
$V_{DS} = 6 \text{ V}; I_{D} = 1 \mu A$	−V <sub>(P)GS</sub>	0,2 to 1	0,5 to 2,5 V
Small-signal common-source characteristics $V_{DS} = 6 \text{ V}; V_{GS} = 0$			
Transfer admittance*			
f = 1 kHz	y <sub>fs</sub>	> 1,2	2,5 mS
Output admittance at f = 1 kHz**	y <sub>os</sub>	typ. 10	50 mS
Input capacitance at f = 1 MHz			
diodes not connected	Cis	< 5	5 pF
Diode capacitance V <sub>D</sub> = 0; source and drain not connected	C	tup 0.7	0.7 nF
Diode forward voltage	Cd	typ. 0,7	0,7 pF
± IF = 10 mA	VF	0,7 to 1,2	0,7 to 1,2 V
			1

<sup>\*</sup> Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

<sup>\*\*</sup> Measured under pulse conditions:  $t_p$  = 100 ms;  $\delta \le$  0,1.

# N-P-N H.F. WIDEBAND TRANSISTOR

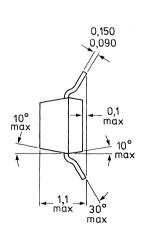
N-P-N transistor in a plastic SOT-23 envelope. It is intended for a wide range of v.h.f. and u.h.f. applications in thick and thin-film circuits.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter; peak value)	V <sub>CBOM</sub>	max.	25	V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	15	V
Collector current (peak value)	<sup>I</sup> CM	max.	50	mA
Total power dissipation up to T <sub>amb</sub> = 65 °C	$P_{tot}$	max.	250	mW
Junction temperature	$T_{i}$	max.	175	oC
D.C. current gain $I_C = 2 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	20 to	150	
Transition frequency $I_C = 25 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $f = 500 \text{ MHz}$	f <sub>T</sub>	typ.	1,3	GHz
Noise figure $I_C = 2 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$ ; $R_S = 50 \Omega$ ; $f = 500 \text{ MHz}$	F	typ.	4,5	dB

#### **MECHANICAL DATA**

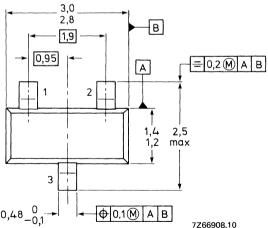
Fig. 1 SOT-23.







Marking code



TOP VIEW

If required, the R-version (reverse pinning) is available on request.

RATINGS				
Limiting values in accordance with the Absolute Maximum System (	IEC 134)			
Collector-base voltage (open emitter; peak value)	V <sub>СВОМ</sub>	max.	25	V
Collector-emitter voltage (open base) $I_C = 10 \text{ mA}$	V <sub>CEO</sub>	max.	15	<b>V</b>
Emitter-base voltage (open collector)	VEBO	max.	2,5	V
Collector current (d.c.)	Ic	max.	25	mΑ
Collector current (peak value)	I <sub>CM</sub>	max.	50	mΑ
Total power dissipation up to T <sub>amb</sub> = 65 °C**	P <sub>tot</sub>	max.	250	mW
Storage temperature	T <sub>stq</sub>	-65 to +	175	оС
Junction temperature	T <sub>i</sub>	max.	175	oC
THERMAL CHARACTERISTICS*	•			
THERMAL CHARACTERISTICS*				
$T_{j} = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	. = '	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0$ ; $V_{CB} = 10 \text{ V}$	Ісво	max.	10	nA
$I_E = 0$ ; $V_{CB} = 10 \text{ V}$ ; $T_j = 100 ^{\circ}\text{C}$	Ісво	max.	10	μΑ
D.C. current gain				
$I_C = 2 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE	20 to		
$I_C = 25 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	min.	20	
Transition frequency				
I <sub>C</sub> = 2 mA; V <sub>CE</sub> = 5 V; f = 500 MHz	fT	typ.		GHz
I <sub>C</sub> = 25 mA; V <sub>CE</sub> = 5 V; f = 500 MHz	fT	typ.	1,3	GHz
Collector capacitance at f = 1 MHz I <sub>E</sub> = I <sub>e</sub> = 0; V <sub>CB</sub> = 10 V	C <sub>c</sub>	max.	1,5	pF

<sup>\*</sup> See Thermal characteristics.
\*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

-45 dB

dim

typ.

Emitter capacitance at f = 1 MHz  $I_C = I_c = 0$ ;  $V_{EB} = 0.5 \text{ V}$  $C_{e}$ 2,0 pF max. Feedback capacitance at f = 1 MHz  $I_C = 1 \text{ mA}; V_{CE} = 5 \text{ V}$ 0,65 pF  $C_{re}$ typ. Noise figure\*  $I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V};$ f = 500 MHz;  $R_S = 50 \Omega$ 4,5 dB typ. Intermodulation distortion  $I_C$  = 10 mA;  $V_{CE}$  = 6 V;  $R_L$  = 37,5  $\Omega$ ;  $T_{amb}$  = 25 °C  $V_o$  = 100 mV at  $f_p$  = 183 MHz  $V_o$  = 100 mV at  $f_q$  = 200 MHz measured at f(2q-p) = 217 MHz

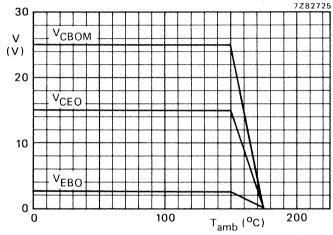
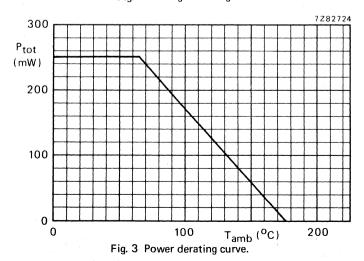
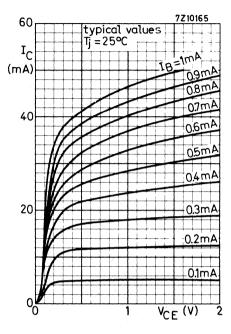


Fig. 2 Voltage derating curve.



\* Crystal mounted in a BFY90 envelope.



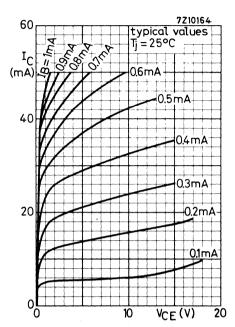
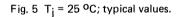


Fig. 4  $T_i = 25$  °C; typical values.



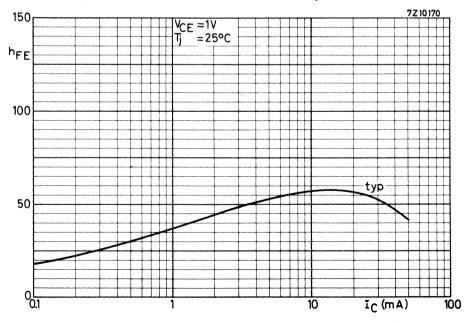


Fig. 6  $V_{CE} = 1 V$ ;  $T_j = 25 \, {}^{o}C$ ; typical values.

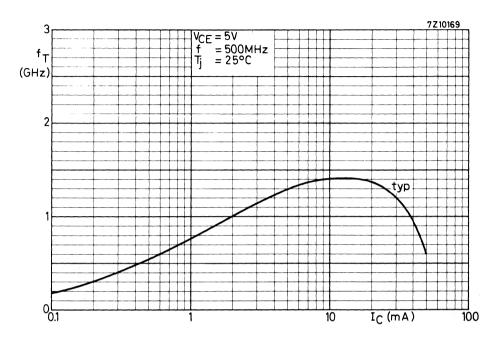


Fig. 7  $V_{CE}$  = 5 V; f = 500 MHz;  $T_j$  = 25  $^{o}$ C; typical values.

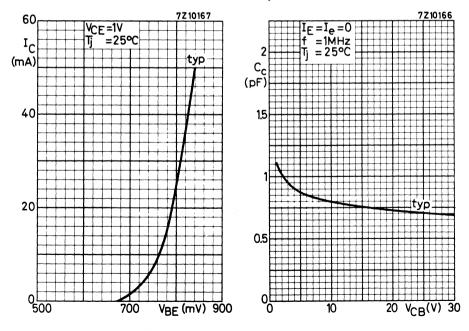


Fig. 8  $V_{CE} = 1 \text{ V}$ ;  $T_j = 25 \text{ }^{\circ}\text{C}$ ; typical values.

Fig. 9  $I_E = I_e = 0$ ; f = 1 MHz;  $T_j = 25 \, ^{\circ}\text{C}$ ; typical values.

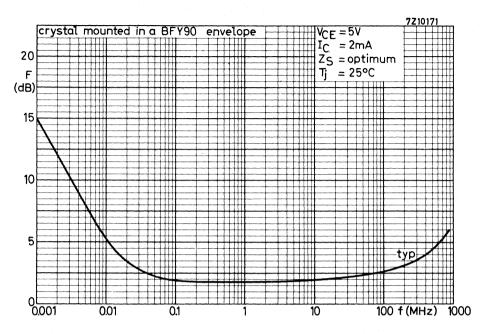
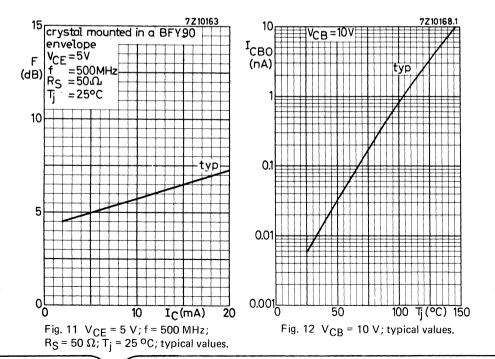


Fig. 10  $V_{CE} = 5 \text{ V}$ ;  $I_C = 2 \text{ mA}$ ;  $Z_S = \text{optimum}$ ;  $T_j = 25 \text{ }^{\circ}\text{C}$ ; typical values.

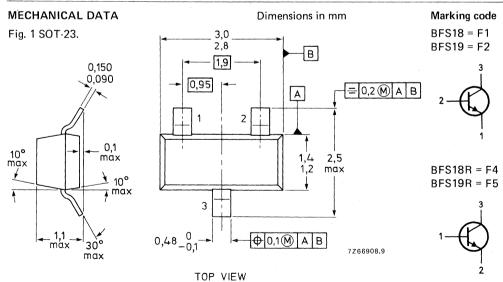


### SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature plastic envelope. They are intended for general purpose and h.f. applications in thick and thin-film circuits.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$V_{CBO}$	max.	3	30	
Collector-emitter voltage (open base)	$v_{CEO}$	max.	2	20	
Collector current (d.c.)	1 <sub>C</sub>	max.	3	30	mA
Total power dissipation up to $T_{amb} = 40$ °C	$P_{tot}$	max.	250		mW
Junction temperature	$T_{j}$	max.	15	50	oC
D.C. current gain IC = 1 mA; VCF = 10 V	hFE		BFS18 35 to 125	BFS19 65 to 225	
Transition frequency at f = 100 MHz	"FE		33 to 123	03 10 223	
I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 10 V	fŢ	typ.	200	260	MHz
Noise figure at f = 100 MHz					
$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}; G_S = 10 \text{ mS}$	F	typ.		4	dB



R-types are available on request. See also *Soldering recommendations*.

RATINGS				
Limiting values in accordance with the Absolute Ma	ximum Syste	m (IEC	: 134)	
Collector-base voltage (open emitter) See Fig. 2	V <sub>CBO</sub>	max.	30	V
Collector-emitter voltage (open base) See Fig. 2	V <sub>CEO</sub>	max.	20	V
Emitter-base voltage (open collector) See Fig. 2	$V_{EBO}$	max.	5	V
Collector current (d.c.)	I <sub>C</sub>	max.	30	mΑ
Collector current (peak value)	ICM	max.	30	mΑ
Total power dissipation up to $T_{amb} = 40  {}^{\circ}C^{**}$	$P_{tot}$	max.	250	mW
Storage temperature	T <sub>stg</sub>		-65 to + 150	oC
Junction temperature	Тj	max.	150	oC
THERMAL CHARACTERISTICS*				
$T_j = P(R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	==	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$	<sup>I</sup> CBO	<	100	nA
$I_E = 0$ ; $V_{CB} = 20 \text{ V}$ ; $T_j = 100 ^{\circ}\text{C}$	I <sub>CBO</sub>	<	10	μΑ
Base-emitter voltage				
$I_C = 1 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	$V_{BE}$		0,65 to 0,74	V

			BFS18	BFS19	
D.C. current gain $I_C = 1 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	hFE		35 to 125	65 to 225	•
Transition frequency at f = 100 MHz I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 10 V	f <sub>T</sub> 1	typ.	200	260	MHz
Collector capacitance at f = 1 MHz $I_E = I_e = 0$ ; $V_{CB} = 10 V$	C <sub>C</sub> 1	typ.		1	рF
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 1 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	-C <sub>re</sub>	typ.	0,8	15	pF
Noise figure ▲ IC = 1 mA; V <sub>CE</sub> = 10 V;					
$G_S = 10 \text{ mS}$ ; $f = 100 \text{ MHz}$	ov[Fa] ja	typ.		4	dB

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.

<sup>▲</sup> Crystal mounted in a BF115 enve

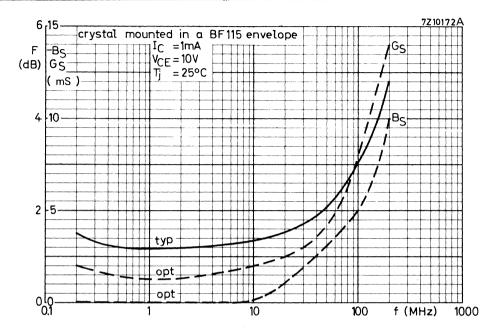


Fig. 2.

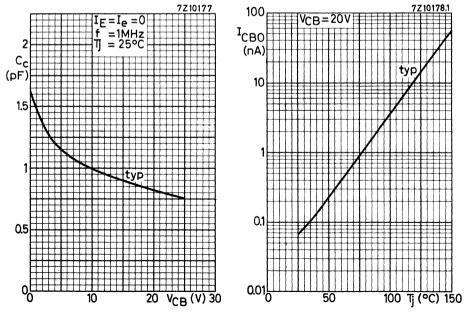


Fig. 3.

Fig. 4.



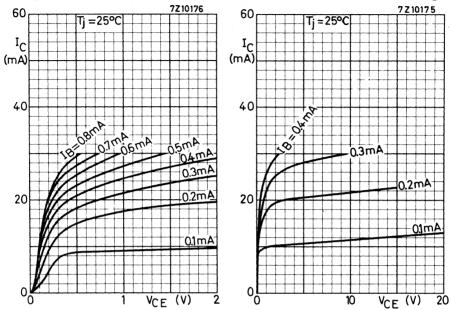


Fig. 5.

Fig. 6.

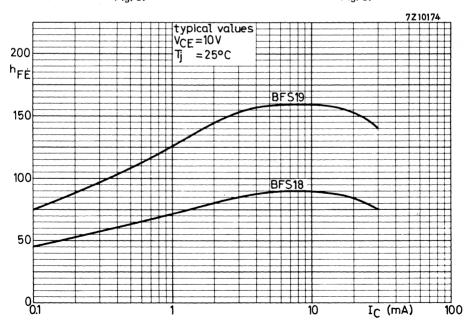


Fig. 7.

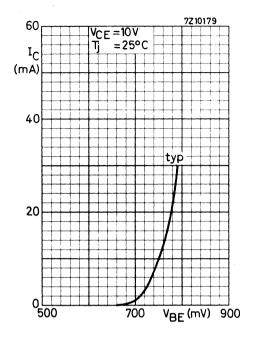


Fig. 8.

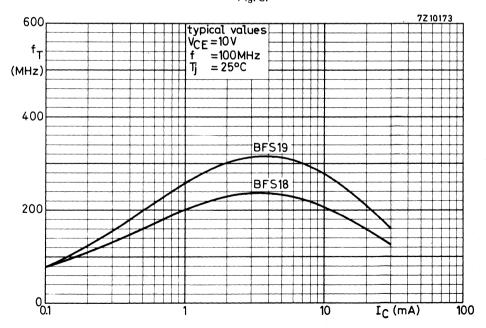


Fig. 9.

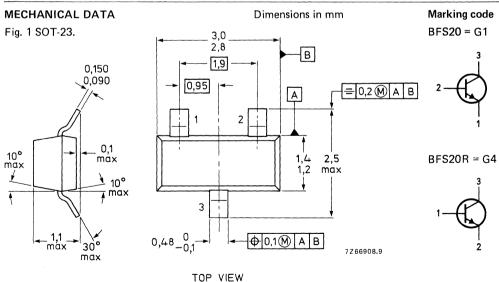


### SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistor in a microminiature plastic envelope. It has a very low feedback capacitance and is intended for i.f. and v.h.f. applications in thick and thin-film circuits.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	30 V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	20 V
Collector current (d.c.)	<sup>I</sup> C	max.	25 mA
Total power dissipation up to T <sub>amb</sub> = 40 °C	$P_{tot}$	max.	250 mW
Junction temperature	Τį	max.	150 °C
D.C. current gain $I_C = 7 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	hFE	>	40
Transition frequency at $f = 100 \text{ MHz}$ $I_C = 5 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	f <sub>T</sub>	typ.	450 MHz
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 1 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	C <sub>re</sub>	typ.	350 fF



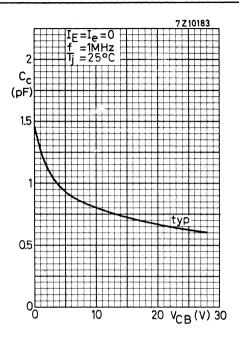
R-types are available on request

See also Soldering recommendations.

### **RATINGS**

C 134)			
V <sub>CBO</sub>	max.	30	V
V <sub>CEO</sub>	max.	20	<b>V</b>
	max.	4	V
	max.	25	mΑ
-	max.	25	mΑ
	max.	250	mW
	-65 to	+ 150	οС
Tj	max.	150	oC
R <sub>th j-t</sub>	= .	60	K/W
R <sub>th t-s</sub>	1000M 450m	280	K/W
R <sub>th s-a</sub>	=	90	K/W
ІСВО	<	10	μΑ
		740	.,
$V_{BE}$	typ.		m V mV
hFE		40 85	
$f_{T}$			MHz MHz
	-117'		
$C_{c}$	typ.	0,8	pF
-C <sub>re</sub>	typ.	350	fF
	VCEO VEBO IC ICM Ptot Tstg Tj  Rth j-t Rth t-s Rth s-a  ICBO ICBO VBE  hFE fT Cc	VCEO max. VEBO max. IC max. ICM max. Ptot max. Tstg -65 to Tj max.  Rth j-t = Rth t-s = Rth s-a =  ICBO < ICBO < VBE   Typ.  typ.  fT   typ.  Cc typ.	VCEO max. 20 VEBO max. 4 IC max. 25 ICM max. 25 Ptot max. 250 Tstg -65 to +150 Tj max. 150  Rth j-t = 60 Rth t-s = 280 Rth s-a = 90  ICBO < 100 ICBO < 10  VBE < 900  hFE > 40 typ. 740 900  hFE > 275 typ. 450  Cc typ. 0,8

<sup>\*</sup> See Thermal characteristics. \*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.



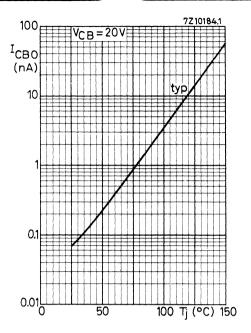
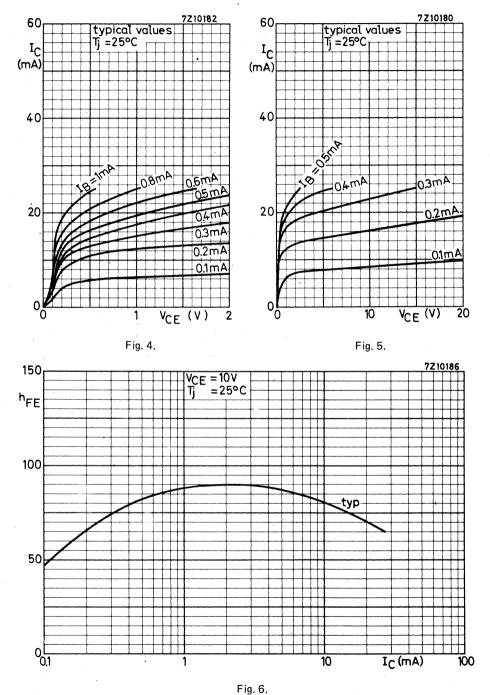


Fig. 2.

Fig. 3.



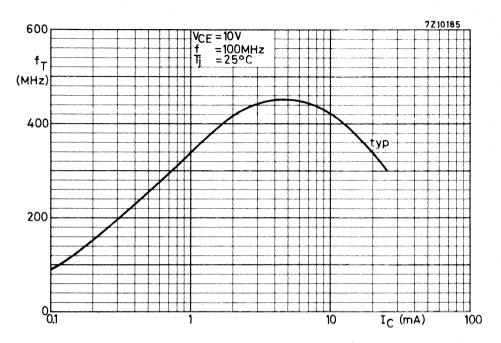


Fig. 7.

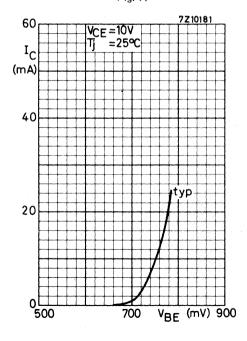


Fig. 8.

### N-P-N H.F. WIDEBAND TRANSISTOR

N-P-N transistor in a plastic SOT-23 envelope, primarily intended for use in u.h.f. low power amplifiers in thick and thin-film circuits, such as in pocket phones, paging systems, etc. The transistor features low current consumption (100  $\mu$ A -1 mA); thanks to its high transition frequency, it also has excellent wideband properties and low noise up to high frequencies.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$v_{CBO}$	max.	8	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	5	V
Collector current (d.c.)	I <sub>C</sub>	max.	6,5	mΑ
Total power dissipation up to T <sub>amb</sub> = 125 °C	$P_{tot}$	max.	50	mW
Junction temperature	Тj	max.	150	оС
Transition frequency at $f = 500 \text{ MHz}$ $I_C = 1 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	fŢ	typ.	2,3	GHz
Feedback capacitance at $f = 1 \text{ MHz}$ $I_C = 1 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	C <sub>re</sub>	max.	0,45	pF
Noise figure at optimum source impedance $I_C = 1 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$ ; $f = 500 \text{ MHz}$	F	typ.	3,8	dB
Max. unilateral power gain $I_C = 1 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$ ; $f = 500 \text{ MHz}$	G <sub>UM</sub>	typ.	18	dB

#### **MECHANICAL DATA** Dimensions in mm Marking code Fig. 1 SOT-23. 3,0 BFT25 = V1 2,8 В 1,9 0,150 0,090 0,95 = 0,2 (M) A B Α 2 0,1 10° 2,5 máx max max ₹ 10° → max 3 1,1 max Ф 0,1(M) 30° 7266908.10

TOP VIEW

If required, the R-version (reverse pinning) is available on request.

max

# RATINGS

RATINGS					
Limiting values in accordance with the Absolute Maximum System (	IEC 134)				
Collector-base voltage (open emitter)	$V_{CBO}$	max.	8	V	
Collector-emitter voltage (open base)	VCEO	max.	5	V	
Emitter-base voltage (open collector)	$V_{EBO}$	max.	2	V	
Collector current (d.c.)	Ic	max.	6,5	mΑ	
Collector current (peak value; f > 1 MHz)	ICM	max.	10	mΑ	
Total power dissipation up to T <sub>amb</sub> = 125 °C**	P <sub>tot</sub>	max.	50	mW	
Storage temperature	$T_{stg}$	-65 to +	150	$^{\rm o}{\rm C}$	
Junction temperature	$T_{\hat{j}}$	max.	150	oC	
THERMAL CHARACTERISTICS*					
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab	R <sub>th j-t</sub>	=	60	K/W	
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W	
From soldering points to ambient**	R <sub>th s-a</sub>	= '	90	K/W	
CHARACTERISTICS					
$T_j = 25$ °C unless otherwise specified					
Collector cut-off current I <sub>E</sub> = 0; V <sub>CB</sub> = 5 V	I <sub>CBO</sub>	max.	50	nA	
D.C. current gain $I_C = 10 \mu A$ ; $V_{CE} = 1 V$	hFE	min. typ.	20 30		
$I_C = 1 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	min. typ.	20 40		
Saturation voltages $I_C = 10 \mu A$ ; $I_B = 1 \mu A$	V <sub>CEsat</sub> V <sub>BEsat</sub>	max. max.	200 750		
$I_C = 1 \text{ mA}; I_B = 0.1 \text{ mA}$	V <sub>CEsat</sub> V <sub>BEsat</sub>	max. max.	175 900		
Transition frequency at f = 500 MHz I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 1 V	f <sub>T</sub>	min. typ.	•	GHz GHz	

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.

Collector capacitance at f = 1 MHz  $I_E = I_e = 0$ ;  $V_{CB} = 0.5 \text{ V}$  $C_{c}$ max. 0,6 pF Emitter capacitance at f = 1 MHz  $I_C = I_c = 0$ ;  $V_{EB} = 0$ 0,5 pF Feedback capacitance at f = 1 MHz  $C_{re}$  $I_C = 1 \text{ mA}; V_{CF} = 1 \text{ V}; T_{amb} = 25 \text{ °C}$ max. 0,45 pF Noise figure at optimum source impedance  $I_C$  = 0,1 mA;  $V_{CE}$  = 1 V; f = 500 MHz;  $T_{amb}$  = 25 °C · typ. 5,5 dB  $I_C = 1 \text{ mA}$ ;  $V_{CE} = 1 \text{ V}$ ; f = 500 MHz;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ typ. 3,8 dB Maximum unilateral power gain ( $s_{re}$  assumed to be zero)  $G_{UM}$  (in dB) = 10 log  $\frac{|s_{fe}|^2}{(1 - |s_{ie}|^2)(1 - |s_{oe}|^2)}$  $I_C$  = 1 mA;  $V_{CE}$  = 1 V; f = 200 MHz;  $T_{amb}$  = 25 °C  $I_C$  = 1 mA;  $V_{CE}$  = 1 V; f = 500 MHz;  $T_{amb}$  = 25 °C GUM 25.0 dB typ. 18,0 dB GUM typ.  $I_C = 1 \text{ mA}$ ;  $V_{CE} = 1 \text{ V}$ ; f = 800 MHz;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ 12.0 dB GUM typ.

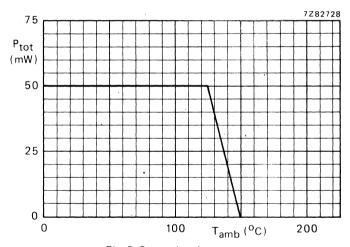
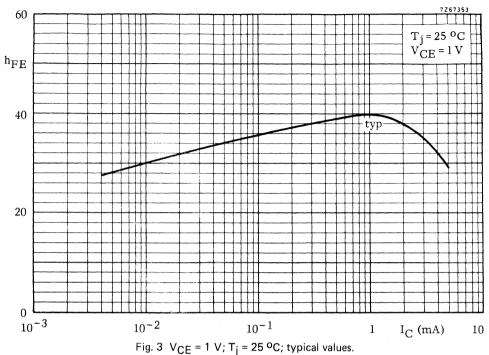


Fig. 2 Power derating curve.



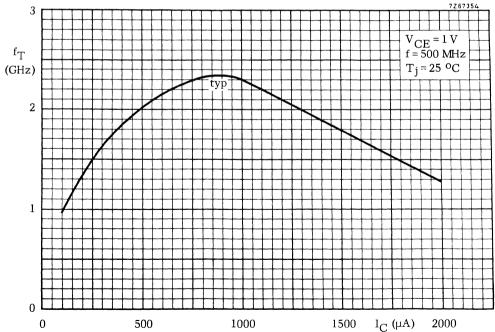


Fig. 4  $V_{CE}$  = 1 V; f = 500 MHz;  $T_j$  = 25 °C; typical values.

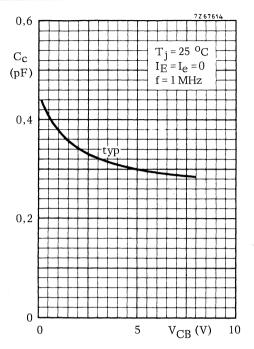


Fig. 5  $I_E = I_e = 0$ ; f = 1 MHz;  $T_j = 25$  °C; typical values.

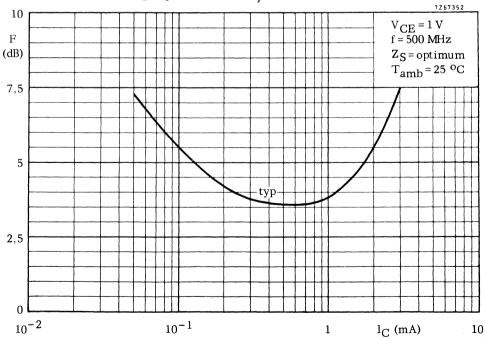


Fig. 6  $V_{CE}$  = 1 V; f = 500 MHz;  $Z_{S}$  = opt.;  $T_{amb}$  = 25  $^{o}C$ ; typical values.

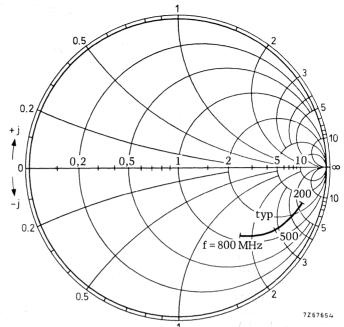


Fig. 7  $V_{CE}$  = 1 V;  $I_{C}$  = 1 mA;  $T_{amb}$  = 25 °C; typical values.

Input impedance derived from input reflection coefficient  $s_{ie}$  coordinates in ohm x 50

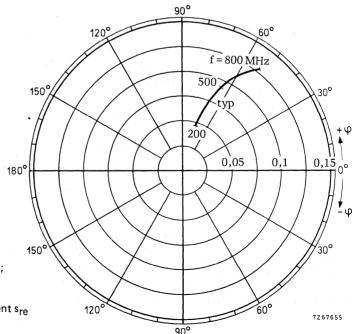


Fig. 8  $V_{CE} = 1 \text{ V; } I_{C} = 1 \text{ mA;}$  $T_{amb} = 25 {}^{o}\text{C; typical values.}$ 

Reverse transmission coefficient  $\mathbf{s}_{\text{re}}$ 

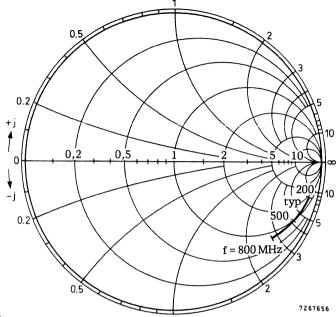


Fig. 9  $V_{CE}$  = 1 V;  $I_{C}$  = 1 mA;  $T_{amb}$  = 25  $^{o}$ C; typical values.

Output impedance derived from output reflection coefficient soe coordinates in ohm x 50

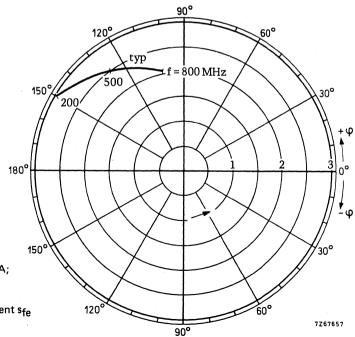


Fig. 10  $V_{CE} = 1 \text{ V}$ ;  $I_{C} = 1 \text{ mA}$ ;  $T_{amb} = 25 \, ^{o}\text{C}$ ; typical values.

Forward transmission coefficient  $s_{\mbox{\it fe}}$ 



Marking code

# N-CHANNEL SILICON FET

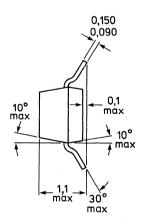
N-channel silicon epitaxial planar junction field-effect transistor in a microminiature plastic envelope. The transistor is intended for low level general purpose amplifiers in thick and thin-film circuits.

# **QUICK REFERENCE DATA**

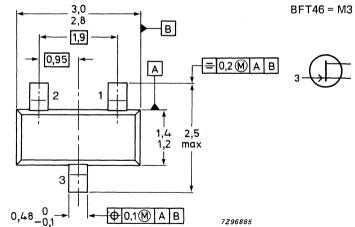
Drain-source voltage	±V <sub>DS</sub>	max.	25 V
Gate-source voltage (open drain)	-V <sub>GSO</sub>	max.	25 V
Total power dissipation up to T <sub>amb</sub> = 65 °C	P <sub>tot</sub>	max.	250 mW
Drain current $V_{DS} = 10 \text{ V}$ ; $V_{GS} = 0$	I <sub>DSS</sub>	> <	0,2 mA 1.5 mA
Transfer admittance (common source) ID = 0,2 mA; VDS = 10 V; f = 1 kHz	y <sub>fs</sub>	>	0,5 mS
Equivalent noise voltage $V_{DS}$ = 10 V; $I_D$ = 200 $\mu$ A; B = 0,6 to 100 Hz	$V_n$	<	0,5 μV

# **MECHANICAL DATA**

Fig. 1 SOT-23.



Dimensions in mm



TOP VIEW

See also Soldering recommendations.

# **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$^{\pm }V_{DS}$	max.	25	٧
Drain-gate voltage (open source)	$V_{DGO}$	max.	25	٧
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25	٧
Drain current	ID	max.	10	mΑ
Gate current	IG	max.	5	mΑ
Total power dissipation up to T <sub>amb</sub> = 65 °C **	$P_{tot}$	max.	250	mW
Storage temperature range	$T_{stg}$	-65 to	+175	oC
Junction temperature	Tj	max.	175	oC

# THERMAL CHARACTERISTICS\*

$$R_{th j-t} + R_{th t-s} + R_{th s-a} = \frac{T_j - T_{amb}}{P}$$

### Thermal resistance

Morrial Todotario			
From junction to tab	R <sub>th j-t</sub>	= -	60 K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280 K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90 K/W
CHARACTERISTICS			
T <sub>i</sub> = 25 °C unless otherwise specified			

$I_j = 25$ °C unless otherwise speci	fied
Gate cut-off current	

$-V_{GS} = 10 V; V_{DS} = 0$	-I <sub>GSS</sub>	<	0,2 nA
Drain current ** $V_{DS} = 10 \text{ V}; V_{GS} = 0$	I <sub>DSS</sub>	> <	0,2 mA 1,5 mA
Gate-source voltage $I_D = 50 \mu A$ ; $V_{DS} = 10 V$	-V <sub>GS</sub>	> <	0,1 V 1,0 V
Gate-source cut-off voltage	-V(P)GS	<	1,2 V

y-parameters at f = 1 kHz;			
$V_{DS} = 10 \text{ V}; V_{GS} = 0; T_{amb} = 25 ^{\circ}\text{C}$			
Transfer admittance	y <sub>fs</sub>	>	1,0 mS
Output admittance	lyosl	< '	10 μS
$V_{DS} = 10 \text{ V}; I_D = 200 \mu\text{A};$			
Transfer admittance	Vfc	>	0.5 mS

Output admittance

<sup>\*</sup> See *Thermal characteristics*.

\*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Input capacitance at f = 1 MHz;  $V_{DS} = 10 \text{ V; } V_{GS} = 0; T_{amb} = 25 \text{ °C} \qquad \qquad C_{is} \qquad < \qquad 5 \text{ pF}$  Feedback capacitance at f = 1 MHz;  $V_{DS} = 10 \text{ V; } V_{GS} = 0; T_{amb} = 25 \text{ °C} \qquad \qquad C_{rs} \qquad < \qquad 1,5 \text{ pF}$  Equivalent noise voltage  $V_{DS} = 10 \text{ V; } I_{D} = 200 \text{ } \mu\text{A; } T_{amb} = 25 \text{ °C}$   $B = 0,6 \text{ to } 100 \text{ Hz} \qquad \qquad V_{n} \qquad < \qquad 0,5 \text{ } \mu\text{V}$ 

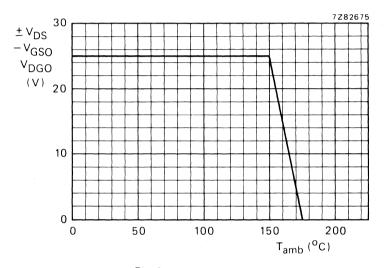


Fig. 2 Voltage derating curve.

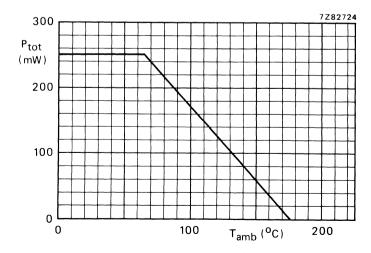
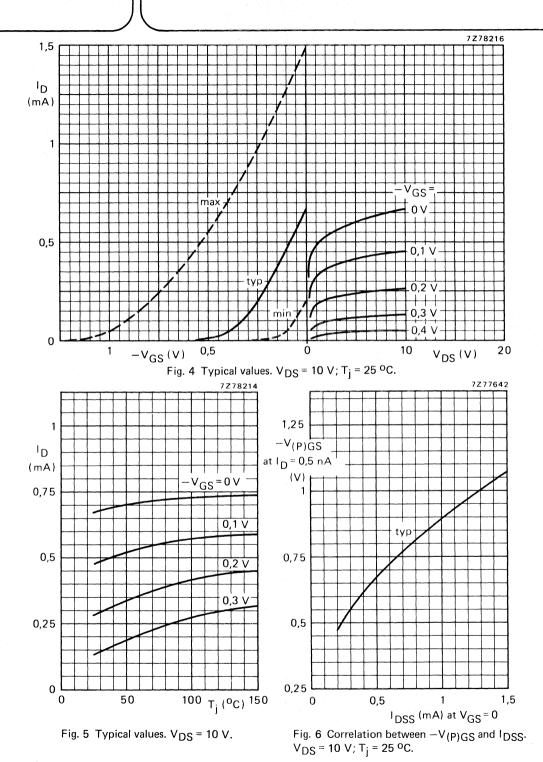
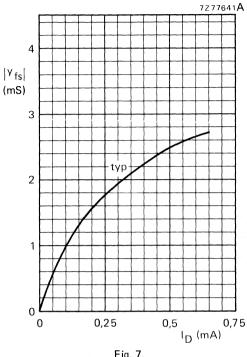


Fig. 3 Power derating curve.



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May 1980



7Z77640**A** 4 y<sub>os</sub> (mS) 3 2 1 0 0,75 I<sub>D</sub> (mA) 0 0,25 0,5

Fig. 7.

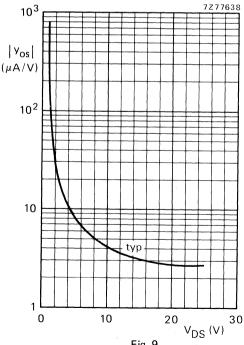


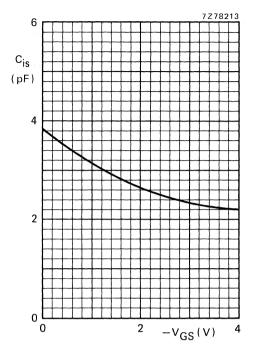
Fig. 9.

Fig. 7  $|y_{fs}|$  versus  $I_D$ .  $V_{DS}$  = 10 V; f = 1 kHz;  $T_{amb}$  = 25 °C.

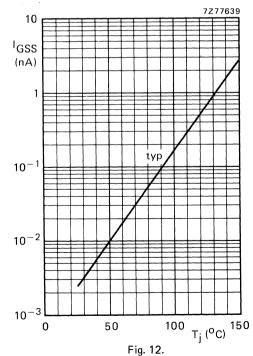
Fig. 8.

Fig. 8  $|y_{OS}|$  versus  $I_D$ .  $V_{DS}$  = 10 V; f = 1 kHz;  $T_{amb}$  = 25 °C.

Fig. 9  $|y_{os}|$  versus  $V_{DS}$ .  $I_D = 0.4$  mA; f = 1 kHz;  $T_{amb} = 25$  °C.







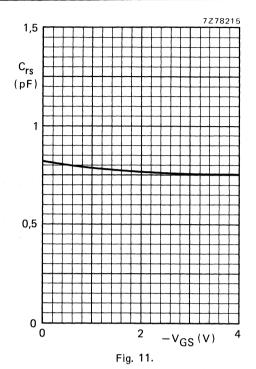
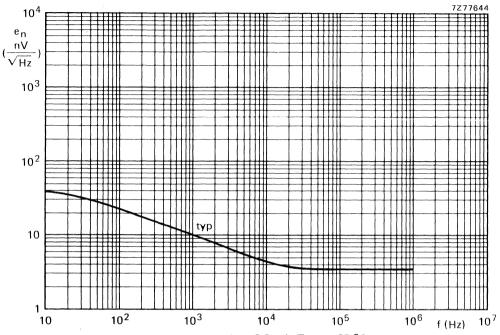


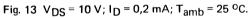
Fig.10 Typical values.  $V_{DS} = 10 \text{ V}, T_{amb} = 25 ^{\circ}\text{C}.$ 

Fig.11 Typical values.

 $V_{DS}$  = 10 V,  $T_{amb}$  = 25 °C.

Fig.12  $I_{GSS}$  versus  $T_j$ .  $-V_{GSS} = 10V$ ;  $V_{DS} = 0$ .





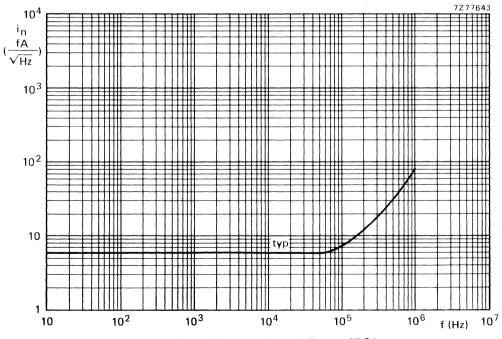


Fig. 14  $V_{DS} = 10 \text{ V}$ ;  $I_D = 0.2 \text{ mA}$ ;  $T_{amb} = 25 \text{ °C}$ .

# SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistor in a microminiature plastic envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analysers, etc.

The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies. N-P-N complements are BFR92 and BFR92A.

# QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	20	٧	_
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	15	V	
Collector current (d.c.)	-I <sub>C</sub>	max.	25	mΑ	
Total power dissipation up to T <sub>amb</sub> = 60 °C	P <sub>tot</sub>	max.	200	mW	
Junction temperature	Ti	max.	150	оС	
Transition frequency at $f = 500 \text{ MHz}$ $-I_C = 14 \text{ mA}; -V_{CE} = 10 \text{ V}$	, f <sub>T</sub>	typ.	5	GHz	
Feedback capacitance at f = 1 MHz -IC = 2 mA; -VCE = 10 V; T <sub>amb</sub> = 25 °C	C <sub>re</sub>	typ.	0,7	pF	
Noise figure at optimum source impedance -I <sub>C</sub> = 2 mA; -V <sub>CE</sub> = 10 V; f = 500 MHz; T <sub>amb</sub> = 25 °C	F	typ.	2,7	dB	
Max. unilateral power gain $-I_C = 14 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$ ; $f = 500 \text{ MHz}$ ; $T_{amb} = 25 \text{ °C}$	G <sub>UM</sub>	typ.	18	dB	
Intermodulation distortion at $T_{amb}$ = 25 °C $-I_C$ = 14 mA; $-V_{CE}$ = 10 V; $R_L$ = 75 $\Omega$ ; $V_o$ = 150 mV	- ***				
f(p+q-r) = 493,25  MHz	d <sub>im</sub>	typ.	-60	dB	

# **MECHANICAL DATA**

(See next page).

#### **MECHANICAL DATA** Dimensions in mm Marking code 3,0 2,8 Fig. 1 SOT-23. BFT92 = W1В 1,9 0,150 0,090 0,95 = 0,2 (M) A B Α 2 0,1 10° max 2,5 max 10° 3 \_ **1,1** . max ф0,1**М** А В 7266908.10 max

TOP VIEW If required, the R-version (reverse pinning) is available on request.

# **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	20	V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	15	$V^{-1}$
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	2	V
Collector current (d.c.)	−I <sub>C</sub>	max.	25	mA .
Collector current (peak value; f > 1 MHz)	<sup>−I</sup> CM	max.	35	mΑ
Total power dissipation up to $T_{amb} = 60  {}^{\circ}C^{**}$	P <sub>tot</sub>	max.	200	mW
Storage temperature	T <sub>stg</sub>	-65 to +	150	oC
Junction temperature	Tj	max.	150	οС

# **THERMAL CHARACTERISTICS \***

$$\mathsf{T}_{j} = \mathsf{P} \; (\mathsf{R}_{th \; j\text{-}t} + \mathsf{R}_{th \; t\text{-}s} + \mathsf{R}_{th \; s\text{-}a}) + \mathsf{T}_{amb}$$

# Thermal resistance

From junction to tab	R <sub>th j-t</sub>	=	60 K/V
From tab to soldering points	R <sub>th t-s</sub>	=	280 K/V
From soldering points to ambient **	R <sub>th s-a</sub>	= ,	90 K/V

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

# **CHARACTERISTICS**

T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified			
Collector cut-off current I <sub>E</sub> = 0; -V <sub>CB</sub> = 10 V	<sup>−l</sup> CBO	max.	50 nA
D.C. current gain $-I_C = 14 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$	hFE	min. typ.	20 50
Transition frequency at $f = 500 \text{ MHz}$ -I <sub>C</sub> = 14 mA; -V <sub>CE</sub> = 10 V	fT	typ.	5,0 GHz
Collector capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0$ ; $-V_{CB} = 10 \text{ V}$	$C_{\mathbf{c}}$	typ.	0,75 pF
Emitter capacitance at $f = 1 \text{ MHz}$ $I_C = I_c = 0$ ; $-V_{EB} = 0.5 \text{ V}$	C <sub>e</sub>	typ.	0,8 pF
T <sub>amb</sub> = 25 °C			
Feedback capacitance at $f = 1 \text{ MHz}$ $-I_C = 2 \text{ mA}; -V_{CE} = 10 \text{ V}$	C <sub>re</sub>	typ.	0,7 pF
Noise figure at optimum source impedance * $-I_C = 2 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$ ; $f = 500 \text{ MHz}$	F	typ.	2,7 dB
Max. unilateral power gain ( $s_{re}$ assumed to be zero) $G_{UM} = 10 \log \frac{ s_{fe} ^2}{(1 -  s_{ie} ^2) (1 -  s_{oe} ^2)}$ $-I_C = 14 \text{ mA}; -V_{CE} = 10 \text{ V}; \text{ f} = 500 \text{ MHz}$	G <sub>UM</sub>	typ.	18,0 dB
Output voltage at $d_{im}$ = -60 dB (see Fig. 2) (DIN 45004B, par. 6.3.: 3-tone) -I <sub>C</sub> = 14 mA; -V <sub>CE</sub> = 10 V; R <sub>L</sub> = 75 $\Omega$ V <sub>p</sub> = V <sub>o</sub> at $d_{im}$ = -60 dB; f <sub>p</sub> = 495,25 MHz V <sub>q</sub> = V <sub>o</sub> -6 dB ; f <sub>q</sub> = 503,25 MHz R <sub>r</sub> = V <sub>o</sub> -6 dB ; f <sub>r</sub> = 505,25 MHz	CIW		
measured at $f(p + q - r)$ = 493,25 MHz	Vo	typ.	150 mV

<sup>\*</sup> Crystal mounted in SOT-37 envelope.

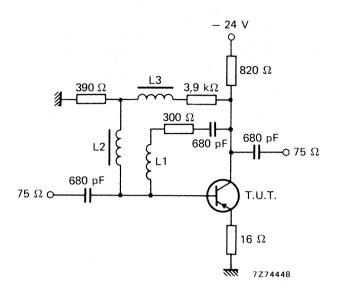


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35 mm); winding pitch 1 mm; int. dia. 4 mm.

L2 = L3 =  $5 \mu H$  (catalogue number: 3122 108 20150).

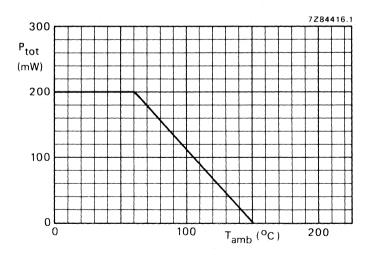


Fig. 3 Power derating curve.

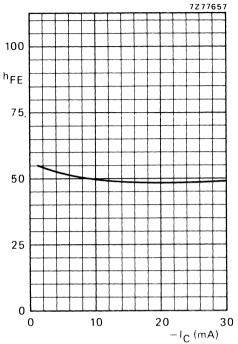


Fig. 4  $-V_{CE} = 10 \text{ V}$ ;  $T_j = 25 \text{ °C}$ ; typical values.

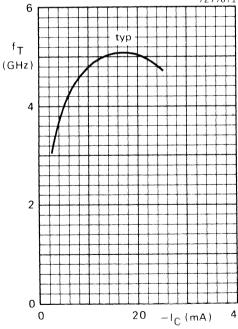


Fig. 6  $-V_{CE}$  = 10 V; f = 500 MHz;  $T_{\hat{j}}$  = 25 °C; typical values.

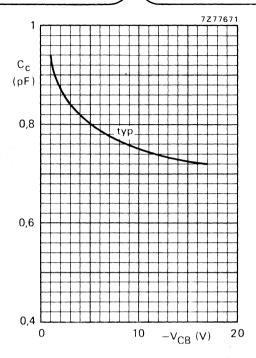


Fig. 5  $I_E = I_e = 0$ ;  $T_j = 25$   $^{o}$ C; f = 1 MHz; typical values.

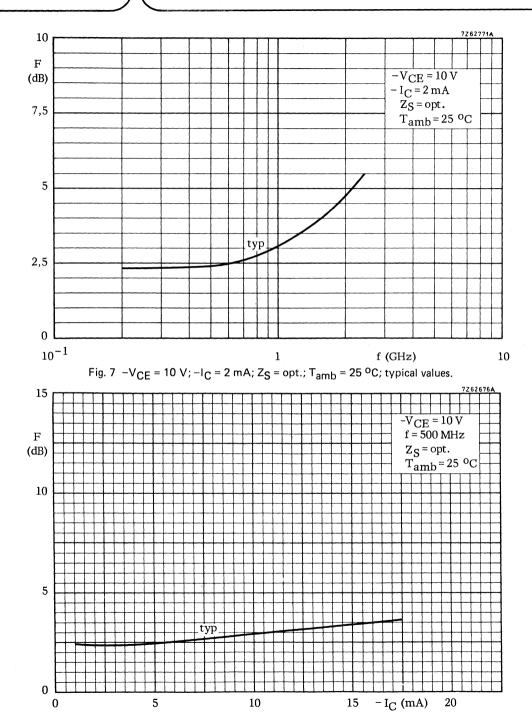


Fig. 8  $-V_{CE}$  = 10 V; f = 500 MHz;  $Z_{S}$  = opt.;  $T_{amb}$  = 25 °C; typical values.

# P-N-P 1 GHz WIDEBAND TRANSISTOR

P-N-P transistor in a plastic SOT-23 envelope. It is primarily intended for use in u.h.f. and microwave amplifiers in thick and thin-film circuits, such as in aerial amplifiers, radar systems, oscilloscopes, spectrum analyses, etc.

The transistor features low intermodulation distortion and high power gain; thanks to its very high transition frequency, it also has excellent wideband properties and low noise up to high frequencies. N-P-N complements are BFR93 and BFR93A.

# QUICK REFERENCE DATA

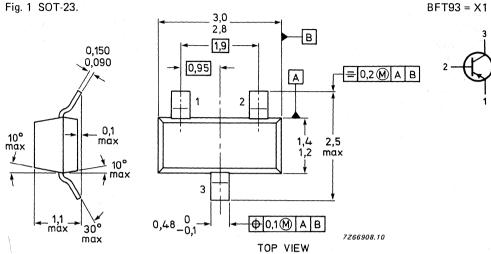
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	15 \	/
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	12 \	<b>/</b>
Collector current (d.c.)	-I <sub>C</sub>	max.	35 n	nΑ
Total power dissipation up to T <sub>amb</sub> = 60 °C	$P_{tot}$	max.	200 n	'nW
Junction temperature	Τį	max.	150 °	С
Transition frequency at $f = 500 \text{ MHz}$ $-I_C = 30 \text{ mA}; -V_{CE} = 5 \text{ V}$	fT	typ.	5,0 0	GHz
Feedback capacitance at f = 1 MHz -I <sub>C</sub> = 2 mA; -V <sub>CE</sub> = 5 V	C <sub>re</sub>	typ.	1,0 p	οF
Noise figure at optimum source impedance $-I_C = 2 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$ ; $f = 500 \text{ MHz}$	F	typ.	2,4 d	зВ
Max. unilateral power gain $-I_C = 30 \text{ mA}; -V_{CE} = 5 \text{ V}; f = 500 \text{ MHz}$	G <sub>UM</sub>	typ.	16,5 d	ıВ
Output voltage at $d_{im}$ = -60 dB -I <sub>C</sub> = 30 mA; -V <sub>CE</sub> = 5 V; R <sub>L</sub> = 75 $\Omega$ f(p+q-r) = 493,25 MHz	V <sub>o</sub>	typ.	300 n	nV

# **MECHANICAL DATA**

Dimensions in mm

Marking code

Fig. 1 SOT-23.



If required, the R-version (reverse pinning) is available on request.

# **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	15	V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	12	V
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	2	V
Collector current (d.c.)	−lc	max.	35	mΑ
Collector current (peak value; f > 1 MHz)	<sup>−l</sup> CM	max.	50	mΑ
Total power dissipation up to $T_{amb} = 60  {}^{\circ}\text{C}^{**}$	$P_{tot}$	max.	200	mW
Storage temperature	T <sub>stg</sub>	-65 to +	150	οС
Junction temperature	$T_{j}$	max.	150	οС

# **THERMAL CHARACTERISTICS \***

$$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$

#### Thermal resistance

From junction to tab	R <sub>th j-t</sub>	=	60 K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280 K/W
From soldering points to ambient **	R <sub>th s-a</sub>	=	90 K/W

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

# CHARACTERISTICS

T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified			
Collector cut-off current			
$I_E = 0$ ; $-V_{CB} = 5 V$	−lCBO	max.	50 nA
D.C. current gain	hFF	min.	20
$-I_C = 30 \text{ mA}; -V_{CE} = 5 \text{ V}$	. –	typ.	50
Transition frequency at f = 500 MHz			
$-I_C = 30 \text{ mA}; -V_{CE} = 5 \text{ V}$	fΤ	typ.	5,0 GHz
Collector capacitance at f = 1 MHz			
$I_E = I_e = 0; -V_{CB} = 10 \text{ V}$	$C_{c}$	typ.	0,95 pF
Emitter capacitance at f = 1 MHz			
$I_C = I_c = 0; -V_{EB} = 0.5 \text{ V}$	$C_{e}$	typ.	1,8 pF
$T_{amb} = 25$ °C			
Feedback capacitance at f = 1 MHz			
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	$C_{re}$	typ.	1,0 pF
Noise figure at optimum source impedance *			
$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}; f = 500 \text{ MHz}$	F	typ.	2,4 dB
Max. unilateral power gain (s <sub>re</sub> assumed to be zero)			
$G_{UM} = 10 \log \frac{ s_{fe} ^2}{(1 -  s_{ie} ^2)(1 -  s_{oe} ^2)}$			
$\frac{10  \text{M}}{(1 -  \mathbf{s}_{ie} ^2)  (1 -  \mathbf{s}_{oe} ^2)}$			
$-I_C = 30 \text{ mA}; -V_{CE} = 5 \text{ V}; f = 500 \text{ MHz}$	$G_{UM}$	typ.	16,5 dB
Output voltage at d <sub>im</sub> = -60 dB (see Fig. 2)			
$-I_C = 30 \text{ mA}; -V_{CE} = 5 \text{ V}; R_L = 75 \Omega$			
$V_p = V_o$ at $d_{im} = -60$ dB; $f_p = 495,25$ MHz			
$V_{q} = V_{o} - 6 \text{ dB}$ ; $f_{q} = 503,25 \text{ MHz}$			
$V_r = V_0 - 6 \text{ dB}$ ; $f_r = 505,25 \text{ MHz}$			
measured at $f(p + q - r)$ = 443,25 MHz	$V_{o}$	typ.	300 mV

<sup>\*</sup> Crystal mounted in SOT-37 envelope.

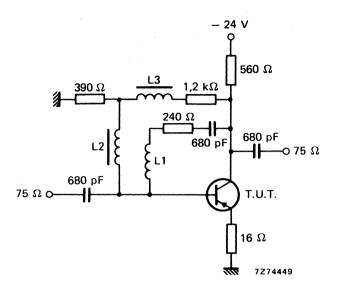


Fig. 2 Intermodulation test circuit.

L1 = 4 turns Cu wire (0,35); winding pitch 1 mm; int. dia. 4 mm. L2 and L3 = 5  $\mu$ H (catalogue number: 3122 108 20150).

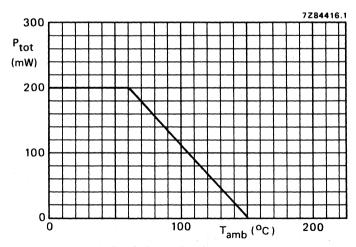
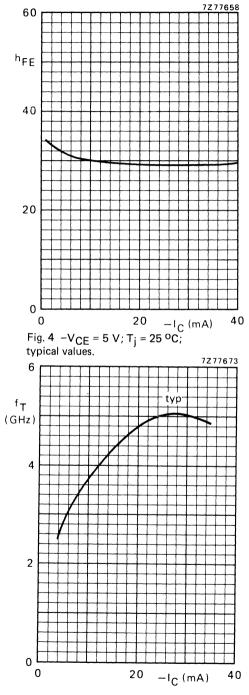


Fig. 3 Power derating curve.



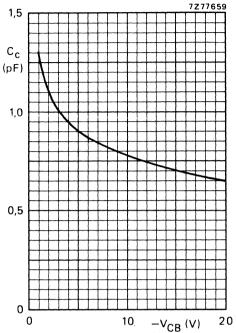


Fig. 5  $I_E = I_e = 0$ ;  $T_j = 25$  °C; f = 1 MHz; typical values.

Fig. 6  $-V_{CE} = 5 \text{ V}$ ;  $T_j = 25 \, ^{\circ}\text{C}$ ;  $f = 500 \, \text{MHz}$ ; typical values.

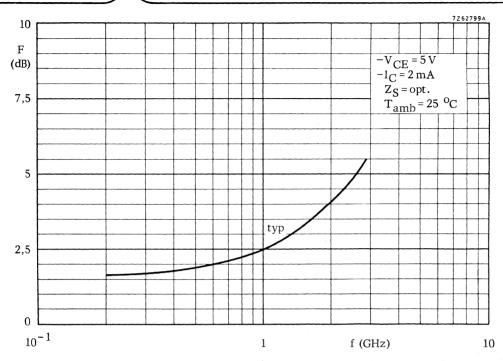


Fig. 7  $-V_{CE} = 5 \text{ V}$ ;  $-I_{C} = 2 \text{ mA}$ ;  $Z_{S} = \text{opt.}$ ;  $T_{amb} = 25 \text{ °C}$ ; typical values.

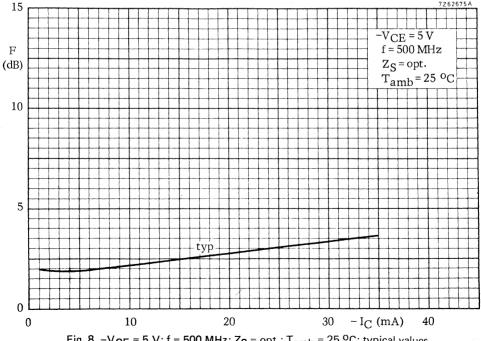


Fig. 8  $-V_{CE}$  = 5 V; f = 500 MHz;  $Z_S$  = opt.;  $T_{amb}$  = 25  $^{o}C$ ; typical values.

# PROGRAMMABLE UNIJUNCTION TRANSISTOR

Planar p-n-p-n trigger device in a microminiature plastic envelope intended for applications in thick and thin-film circuits. It is intended for use in switching applications such as motor control, oscillators, relay replacement, timers, pulse shaper, trigger device etc.

#### QUICK REFERENCE DATA

Gate-anode voltage	$V_{GA}$	max.	70 V
Anode current (d.c.) up to T <sub>amb</sub> = 25 °C	۱A	max.	175 mA
Junction temperature	$T_{i}$	max.	150 °C
Peak point current $V_S = 10 \text{ V}$ ; $R_G = 10 \text{ k}\Omega$	Ιp	<	5 μΑ
Valley point current $V_S = 10 \text{ V}$ ; $R_G = 10 \text{ k}\Omega$	IV	>	30 μΑ

#### **MECHANICAL DATA** Dimensions in mm Marking code Fig. 1 SOT-23. BRY61 = A53,0 2,8 В 1,9 0,150 0,090 0,95 0.2 (M) A B Α 0,1 10° max max 2,5 max ₹ 10° Ţ max 3 Ф 0,1 (M) 30° 7Z66908.9 max TOP VIEW

See also Soldering Recommendations.

# RATINGS

HATINGS				
Limiting values in accordance with the Absolute Maximum Sy	stem (IEC 134)			
Gate-anode voltage	$V_{GA}$	max.	70 V	V
Anode current (d.c.) up to T <sub>amb</sub> = 25 °C	IA	max.	175 r	nΑ
Repetitive peak anode current $t = 10 \mu s$ ; $\delta = 0.01$	IARM	max.	2,5 /	Δ,
Non-repetitive peak anode current $t = 10 \mu s$ ; $T_j = 150  {}^{\circ}\text{C}$	IASM	max.	3 /	Д
Rate of rise of anode current up to I <sub>A</sub> = 2,5 A	$\frac{dI_A}{dt}$	max.	20 /	A/μs
Storage temperature	$T_{stg}$	-65 to	+ 150 °	С
Junction temperature	$T_{j}$	max.	150 °	С
Total power dissipation up to T <sub>amb</sub> = 25 °C**	P <sub>tot</sub>	max.	275 r	ηW
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	=	60 1	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90 (	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Peak point current (see Figs 2, 3 and 4) $V_S$ = 10 V; $R_G$ = 10 k $\Omega$ $V_S$ = 10 V; $R_G$ = 1 M $\Omega$	lр Iр	< 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5 µ	
Valley point current (see also Figs 2, 3 and 4) $V_S$ = 10 V; $R_G$ = 10 k $\Omega$ $V_S$ = 10 V; $R_G$ = 1 M $\Omega$	I <sub>V</sub>	> <	30 µ 50 µ	
Offset voltage (see Fig. 12) $I_A = 0$ (for $V_P$ see Fig. 2; for $V_S$ see Fig. 4)	$V_{offset}$	= Vp	– Vs. 1	V

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.

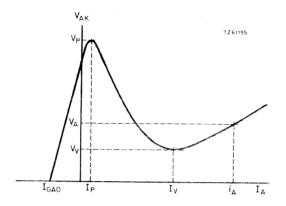


Fig. 2 See also Fig. 11.

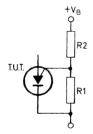


Fig. 3 BRY61 with "program" resistors R1 and R2.

Gate-anode leakage current (Fig. 5a)  $I_K = 0$ ;  $V_{GA} = 70 \text{ V}$  Gate-cathode leakage current (Fig. 5b)  $V_{AK} = 0$ ;  $V_{GK} = 70 \text{ V}$ 

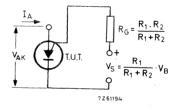
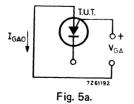
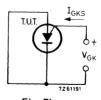


Fig. 4 Equivalent test circuit for characteristics testing.

 $I_{GAO}$  < 10 nA  $I_{GKS}$  < 100 nA





Anode voltage  $I_A = 100 \text{ mA}$   $I_A = 180 \text{ mA}$  Peak output voltage  $V_{AA} = 20 \text{ V}$ ; C = 200 nF (see Fig. 12) Rise time  $V_{AA} = 20 \text{ V}$ ; C = 10 nF (see Fig. 12)

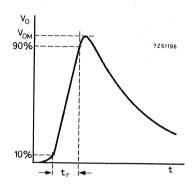
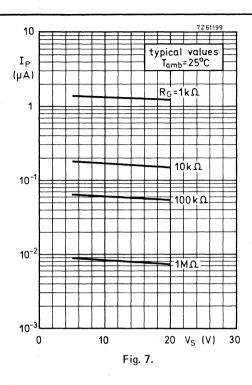
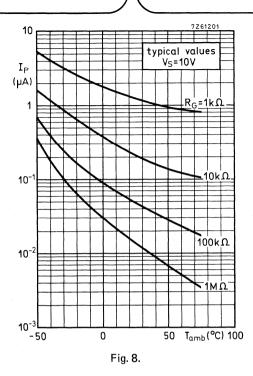
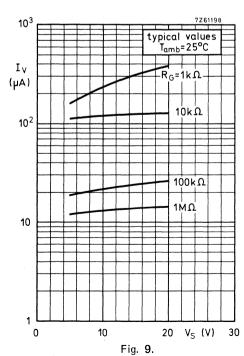
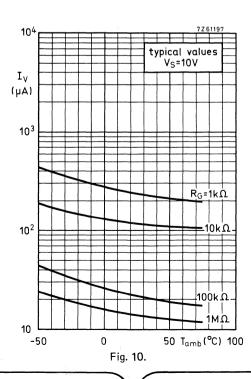


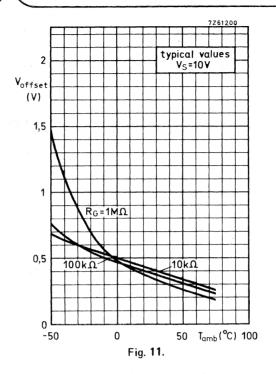
Fig. 6 Output voltage waveform.

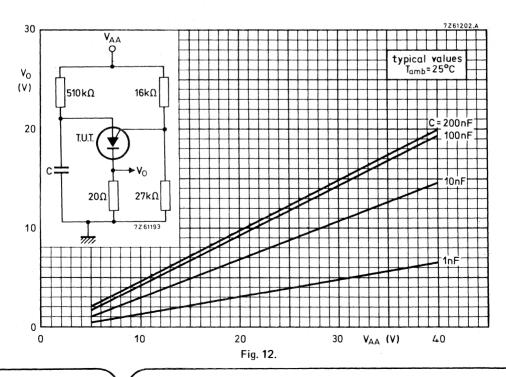












# SILICON P-N-P-N PLANAR TETRODE THYRISTOR

Planar p-n-p-n trigger device in a microminiature plastic envelope. It is intended for use as a programmable trigger device (SCS = silicon controlled switch)

# QUICK REFERENCE DATA

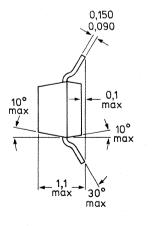
Anode gate — cathode voltage	V <sub>ga-kR</sub>	max.	70 V
Anode gate — anode voltage (open cathode)	V <sub>ga-aO</sub>	max.	70 V
Average anode current	IA(AV)	max.	175 mA
Total power dissipation at $T_{amb} = 25$ °C	P <sub>tot</sub>	max.	275 mW
Junction temperature	T <sub>i</sub>	max.	150 °C
Gate-controlled turn-on time $R_{gk-k}=1 \ k\Omega$	t <sub>gt</sub>	. < 1	0,25 μs
Circuit-commutated turn-off time $R_{gk-k} = 1 \text{ k}\Omega$	tq	<	5 μs

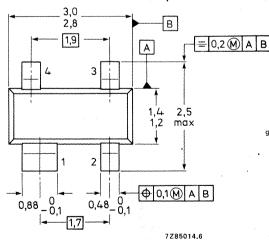
# **MECHANICAL DATA**

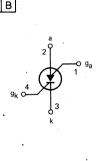
Fig. 1 SOT-143.

### Dimensions in mm

Marking code BRY62 = A51







TOP VIEW

See also Soldering recommendations.

#### **RATINGS**

Transistor 1 (T1)

Limiting values in accordance with the Absolute Maximum System (IEC 134)

11411010101 1 (1 1)	
Collector-base voltage (open emitte	r) -

Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	70	V
Collector-emitter voltage ( $R_{BE}$ = 10 k $\Omega$ )	VCEO	max.	70	٧
Emitter-collector voltage (I <sub>C1</sub> = 0)	VEBO	max.	5	V
Average collector current	<sup>I</sup> C(AV)	max.	175	mA ▲
Collector current (peak value)	<sup>I</sup> CM	max.	175	mA**
Average emitter current	IE(AV)	max.	175	mΑ
Emitter current (peak value) $t_p = 10 \mu s; \delta = 1\%$	IEM	max.	2,5	Α
Transistor 2 (T2)				
Collector-base voltage (I <sub>E2</sub> = 0)	−V <sub>CBO</sub>	max.	70	V
Collector-emitter voltage (I <sub>B2</sub> = 0)	$-V_{CEO}$	max.	70	٧
Emitter-base voltage (I <sub>C2</sub> = 0)	$-V_{EBO}$	max.	70	٧
Emitter current (average)	<sup>I</sup> E(AV)	max.	175	mΑ
Emitter current (peak value) $t_p = 10 \mu s; \delta = 1\%$	<sup>I</sup> EM	max.	2,5	A
Reverse gate to cathode voltage	V <sub>ga-k</sub> R	max.	70	V
Gate to anode voltage (open cathode)	V <sub>ga-aO</sub>	max.	70	٧
Gate to cathode voltage (open anode)	V <sub>gk-kO</sub>	max.	5	٧
Average anode current	IA(AV)	max.	175	mΑ
Anode current (peak value) $t_p = 10 \mu s$ ; $\delta = 1\%$	<sup>I</sup> AM	max.	2,5	A
Anode gate current (average)	IGA(AV)	max.	175	mΑ
Anode gate current (peak value)	IGAM	max.	**	
Total power dissipation at T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	275	mW
Junction temperature	$T_{j}$	max.	150	οС
Storage temperature	T <sub>stg</sub>	-65 to	+ 150	οС
THERMAL RESISTANCE				
Erom junction to ambient*	n .		450	V AM

From junction to ambient\*

450 K/W R<sub>th i-a</sub>

Device mounted on a ceramic substrate of 15 mm x 15 mm x 0,5 mm.

<sup>\*\*</sup> During switching on, the device can withstand the discharge of a capacitor of maximum value of 500 pF. This capacitor is charged when the transistor is in cut-off condition, with a collector supply voltage of 160 V and a series resistance of 100 k $\Omega$ .

Provided the IE rating is not exceeded.

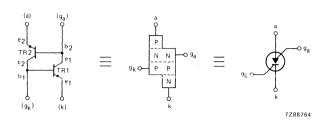


Fig. 2 Circuit diagram.

# CHARACTERISTICS

 $T_i = 25$  °C unless otherwise specified.

# Transistor 1 (TR1)

Collector-emitter cut-off current				
$V_{CE} = 60 \text{ V}; R_{BE} = 10 \text{ k}\Omega$	ICER	<	100	nΑ
$V_{CE} = 70 \text{ V}; R_{BE} = 10 \text{ k}\Omega; T_j = 150 ^{\circ}\text{C}$	ICER	<1	10	μΑ
Emitter cut-off current				
$V_{EB} = 5 \text{ V}; I_{C} = 0; T_{j} = 150 ^{\circ}\text{C}$	<sup>I</sup> EBO	<	10	μΑ
Saturation voltages				
$I_C = 10 \text{ mA}; I_B = 1 \text{ mA}$	$V_{CEsat}$ $V_{BEsat}$	< , <	0,5 0,9	
D.C. current gain				
$V_{CE} = 2 \text{ V; I}_{C} = 10 \text{ mA}$	hFE	>	50	
Collector capacitance				
$V_{CB} = 20 \text{ V}; I_E = I_e = 0$	$C_c$	<	5	pF
Emitter capacitance				
$V_{EB} = 1 V; I_{C} = I_{c} = 0$	$c_{e}$	<	25	pF
Transition frequency at f = 100 MHz				
$V_{CE} = 2 \text{ V; } I_{C} = 10 \text{ mA}$	fT	=	300	MHz
Transistor 2 (TR2)				
Collector-emitter cut-off current				
$-V_{CE} = 70 \text{ V}; I_B = 0; T_j = 150 ^{\circ}\text{C}$	-I <sub>CEO</sub>	<	10	μΑ
Emitter cut-off current				
$-V_{EB} = 70 \text{ V}; I_{C} = I_{c} = 0; T_{j} = 150 ^{\circ}\text{C}$	$-I_{EBO}$	<	10	$\mu$ A
D.C. current gain				
$V_{CB} = 0 \text{ V}; I_E = 1 \text{ mA}$	hFE	0,25 to	2,5	

#### **THYRISTOR**

Anode to cathode On-state voltage  $I_A=50~\text{mA};\ I_{ga}=0;\ R_{gk\text{-}k}=10~\text{k}\Omega$   $I_A=1~\text{mA};\ I_{ga}=10~\text{mA};\ R_{gk\text{-}k}=10~\text{k}\Omega$  Holding current  $I_{ga}=10~\text{mA};\ -V_{gk}=2~\text{V};\ R_{gk\text{-}k}=10~\Omega$ 

# **Switching characteristics**

Gate-controlled turn-on time (t $_{gt}$  = t $_{d}$  + t $_{r}$ ) when switched from V $_{gk}$  = -0,5 V to 4,5 V at R $_{gk-k}$  = 1 k $\Omega$  at R $_{gk-k}$  = 10 k $\Omega$ 

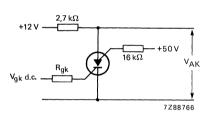
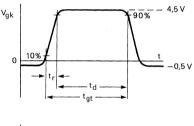


Fig. 3 Switching times test circuit. The pulse time of  $V_{gk}$  can be adjusted in such a way that the broken line in Fig. 4 disappears, which means that the thyristor starts triggering.

<	1,4 V
<	1,2 V
· · · · · · · · · · · · · · · · · · ·	1 mA
	<

$$t_{
m gt}$$
  $<$  0,25  $\mu s$   $t_{
m gt}$   $<$  1,5  $\mu s$ 



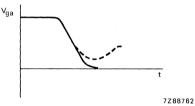


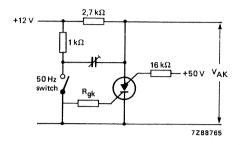
Fig. 4 Switching times waveforms.

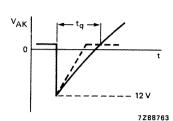
5 μs

8 μs 15 μs

Turn-off time (Figs 5 and 6)

$$\begin{aligned} &R_{gk} = 1 \text{ k}\Omega \\ &R_{gk} = 10 \text{ k}\Omega \\ &R_{gk} = 10 \text{ k}\Omega; T_j = 125 \text{ °C} \end{aligned}$$





 $t_{\boldsymbol{q}}$ 

tq

Fig. 5 Switching times test circuit.

Fig. 6 Switching times waveforms.

The capacitor can be adjusted in such a way that the broken line disappears, which means that the thyristor will not trigger any more.



# MOSFET N-CHANNEL DEPLETION SWITCHING TRANSISTORS

Symmetrical insulated-gate silicon MOS field-effect transistors of the N-channel depletion mode type.

The transistor is sealed in a SOT-143 envelope and features a low ON-resistance and low capacitances.

The transistor is protected against excessive input voltages by integrated back-to-back diodes between gate and substrate.

### Applications:

- analog and/or digital switch
- switch driver
- convertor
- chopper

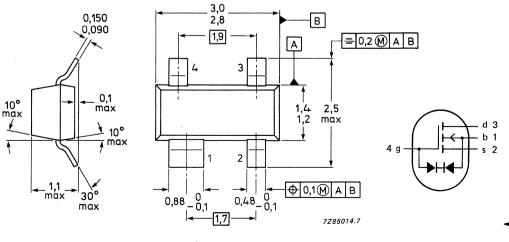
#### QUICK REFERENCE DATA

			BSD20	BSD22	_
Drain-source voltage	VDS	max.	10	20	V
Gate-source voltage	$V_{GS}$	max.	+ 10 30	+ 20 40	•
Drain current (d.c.)	ID	max.	5	50	mΑ
Total power dissipation up to $T_{amb} = 25$ °C	$P_{tot}$	max.	23	30	mW
Junction temperature	Tj	max.	12	25	οС
Drain-source ON-resistance $V_{GS} = 10 \text{ V}; V_{SB} = 0; I_D = 1 \text{ mA}$	R <sub>DSon</sub>	<	3	30	Ω
Feed-back capacitance $V_{GS} = V_{BS} = -5 \text{ V}; V_{DS} = 10 \text{ V}; f = 1 \text{ MHz}$	C <sub>rss</sub>	typ.	0,	,6	pF

### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOT-143.



TOP VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance with the Absolute Maxima	in Oystein (in	5 1047			
			BSD20	BSD22	
Drain-source voltage	$V_{DS}$	max.	10	20	V
Source-drain voltage	$V_{SD}$	max.	10	20	V
Drain-substrate voltage	$V_{DB}$	max.	15	25	V
Source-substrate voltage	$V_{SB}$	max.	15	25	V
Gate-substrate voltage	$V_{GB}$	max.	± 15	± 25	٧
Gate-source voltage	$V_{GS}$	max.	+ 15 -30	+ 15 -40	
Drain current (d.c.)	ID	max.	50		mΑ
Total power dissipation up to $T_{amb} = 25  {}^{o}C^{*}$	P <sub>tot</sub>	max.	230		mW
Storage temperature	$T_{stg}$		65 to + 150		oC
Junction temperature	Tj	max.	125		oC
THERMAL RESISTANCE					
From junction to ambient in free air*	R <sub>th j-a</sub>	= ,	430		K/W
CHARACTERISTICS					
T <sub>amb</sub> = 25 °C unless otherwise specified					
Drain-source breakdown voltage			BSD20	BSD22	
$V_{GS} = V_{BS} = -5 \text{ V}; I_S = 10 \text{ nA}$	V(BR)DSX	>	10	20	٧
Source-drain breakdown voltage $V_{GD} = V_{BD} = -5 \text{ V}; I_D = 10 \text{ nA}$	V <sub>(BR)SDX</sub>	>	10	20	V
Drain-substrate breakdown voltage $V_{GB} = 0$ ; $I_D = 10$ nA; open source	V <sub>(BR)DBO</sub>	>	15	25	V
Source-substrate breakdown voltage $V_{GB} = 0$ ; $I_S = 10 \text{ nA}$ ; open drain	V <sub>(BR)SBO</sub>	>	15	25	V
Drain-source leakage current $V_{GS} = V_{BS} = -5 \text{ V}; V_{DS} = 10 \text{ V}$	DSoff	typ.	1,0	ı	nA
Source-drain leakage current V <sub>GD</sub> = V <sub>BD</sub> = 5 V; V <sub>SD</sub> = 10V	lan ee	tvp	1,0	ı	nA
Gate-substrate leakage current	SDoff	typ.	1,0	•	1174
$V_{DB} = V_{SB} = 0$ ; $V_{GB} = \pm 15 \text{ V}$	IGSoff	<	10	ı	nΑ

<sup>\*</sup> Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Forward transconductance at $f = 1 \text{ kHz}$ $V_{DS} = 10 \text{ V}; V_{SB} = 0; I_D = 20 \text{ mA}$	9fs	> typ.	10 mS 15 mS
Gate-source cut-off voltage $V_{DS} = 10 \text{ V}; V_{SB} = 0; I$ $I_{S} = 10 \mu A$	-V <sub>(P)GS</sub>	<	2,0 V
Drain-source ON-resistance			
I <sub>D</sub> = 1 mA; V <sub>SB</sub> = 0; V <sub>GS</sub> = 5 V	<sup>r</sup> DSon	typ.	25 Ω 50 Ω
V <sub>GS</sub> = 10 V	<sup>r</sup> DSon	typ.	15 Ω 30 Ω
Capacitances at $f = 1 \text{ MHz}$ $V_{GS} = V_{BS} = -5V$ ; $V_{DS} = 10 \text{ V}$			
Feed-back capacitance	C <sub>rss</sub>	typ.	0,6 pF
Input capacitance	Ciss	typ.	1,5 pF
Output capacitance	Coss	typ.	1,0 pF
Switching times (see Fig. 2)			
$V_{DD} = 10 \text{ V}; V_i = -5 \text{ V to } 0 \text{ V}$	t <sub>on</sub> toff	typ.	1,0 ns 5,0 ns

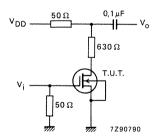


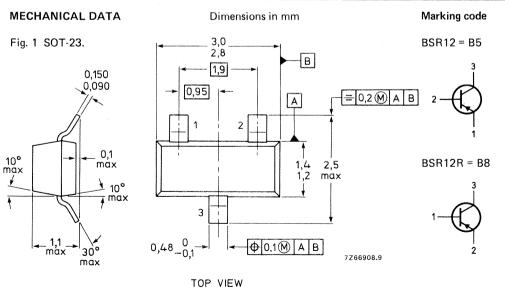
Fig. 2 Switching times test circuit.

# SILICON LOW-POWER SWITCHING TRANSISTORS

P-N-P silicon transistor in a microminiature plastic envelope. It is intended for high-speed, saturated switching applications for industrial service in thick and thin-film circuits.

### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	15 V
Collector-emitter voltage (open base)	-VCEO	max.	15 V
Collector current (peak value)	−lcM	max.	200 mA
Total power dissipation up to $T_{amb} = 65  {}^{o}C$	$P_{tot}$	max.	250 mW
Junction temperature	Ti	max.	175 °C
D.C. current gain $-I_C = 10 \text{ mA}; -V_{CE} = 1 \text{ V} $ $-I_C = 50 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE hFE	> 30 to	30 5 120
Transition frequency at f = 500 MHz $-I_C$ = 50 mA; $-V_{CE}$ = 10 V	fT	>	1,5 GHz
Turn-off time $-I_{Con} = 30 \text{ mA}; -I_{Bon} = +I_{Boff} = 3.0 \text{ mA}$	t <sub>off</sub>	< ,	30 ns



R-types are available on request

See also Soldering recommendations.

RATINGS				
Limiting values in accordance with the Absolute Maximum Sys	tem (IEC 134)			
Collector-base voltage (open emitter) See Fig. 3	-V <sub>CBO</sub>	max.	15	٧
Collector-emitter voltage (open base) See Fig. 3	-V <sub>CEO</sub>	max.	15	٧
Emitter-base voltage (open collector) See Fig. 3	-V <sub>EBO</sub>	max.	3	٧
Collector current (d.c.)	-Ic	max.	100	mΑ
Collector current (peak value)	<sup>−1</sup> CM	max.	200	mΑ
Total power dissipation up to T <sub>amb</sub> = 65 °C**	P <sub>tot</sub>	max.	250	mW
Storage temperature	T <sub>stg</sub>	-65 to +	175	οС
Junction temperature	Tj	max.	175	оС
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	=	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
I <sub>E</sub> = 0; -V <sub>CB</sub> = 10 V	-ICBO	< <		nA ^
I <sub>E</sub> = 0; -V <sub>CB</sub> = 10 V; T <sub>amb</sub> = 125 °C V <sub>BE</sub> = 0; -V <sub>CE</sub> = 10 V	-ICES	<		μA nA
Breakdown voltages				
$I_E = 0; -I_C = 10 \mu A$	-V(BR)CBO	>	15 15	
$V_{BE} = 0; -I_{C} = 10 \mu A$ $I_{C} = 0; -I_{F} = 100 \mu A$	−V(BR)CES −V(BR)EBO	> > >		V
Collector-emitter sustaining voltage	(811)280			
$I_B = 0; -I_C = 10 \text{ mA}$	-V <sub>CEOsust</sub>	>	15	٧
Saturation voltages▲	-V <sub>CEsat</sub>	<	130	mV
$-I_C = 10 \text{ mA}; -I_B = 1 \text{ mA}$	-V <sub>BEsat</sub>	725 to	920	mV
$-I_C = 50 \text{ mA}; -I_B = 5 \text{ mA}$	-V <sub>CEsat</sub>	typ.	180 270	mV mV
	$-V_{BEsat}$	800 to 1	1150	mV
$-I_C = 100 \text{ mA}; -I_B = 10 \text{ mA}$	−V <sub>CEsat</sub> −V <sub>BEsat</sub>	< 900 to 1	450 1500	

- ▲ Measured under pulse conditions;  $t_p$  = 300 μs; δ = 0,01. \* See *Thermal characteristics*.
- \*\* Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

hFE	>	30
hFE	>	30
hFE	30 t	o 120
hFE	>	30
hFE	>	20
fΤ	>	1,5 GHz
$C_{\mathbf{c}}$	<	4,5 pF
$c_{e}$	<	6,0 pF
ton	<	20 ns
toff	<	30 ns
	hFE hFE hFE hFE T C <sub>C</sub> C <sub>e</sub>	hFE 30 th hFE 30

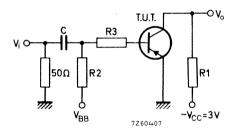


Fig. 2 Test circuit switching times.

Pulse generator		Sampling scope		
Pulse duration Rise time Output impedance	$t_p = 400 \text{ ns}$ $t_r < 1 \text{ ns}$ $Z_0 = 50 \Omega$	Rise time Input impedance	t <sub>r</sub> Z <sub>i</sub>	$<$ 1 ns = 100 k $\Omega$

	V <sub>i</sub> V	V <sub>BB</sub> V	R1 Ω	R2 kΩ	R3 kΩ	-I <sub>Con</sub> mA	-I <sub>Bon</sub> mA	I <sub>Boff</sub> mA	C μF
ton	-6,85	0	94	1,0	2,0	30	3,0	and the second	0,1
toff	11,7	-9,85	94	1,0	2,0	30	3,0	3,0	0,1

<sup>\*</sup> Measured under pulse conditions;  $t_p$  = 300  $\mu$ s;  $\delta$  = 0,01.

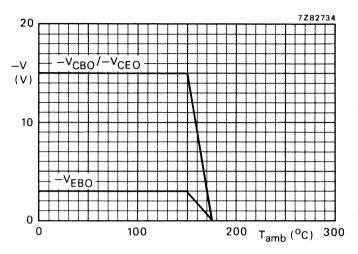


Fig. 3 Voltage derating curves.

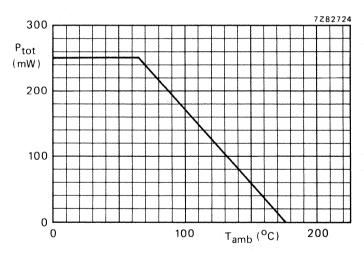


Fig. 4 Power derating curve.

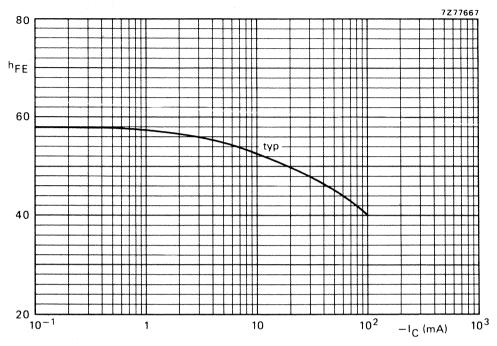


Fig. 5  $-V_{CE} = 1 \text{ V}$ ;  $T_{amb} = 25 \text{ }^{\circ}\text{C}$ .

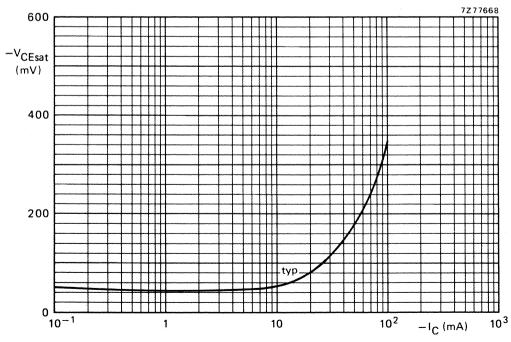


Fig. 6  $V_{CEsat}$  as a function of  $I_{C}$  at  $I_{C}/I_{B}$  = 10.

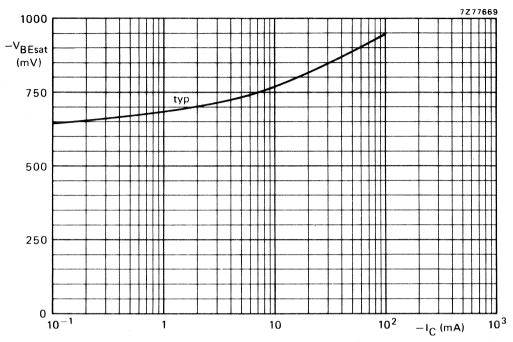


Fig. 7 V<sub>BEsat</sub> as a function of I<sub>C</sub> at I<sub>C</sub>/I<sub>B</sub> = 10.

600

-V<sub>CEsat</sub>
(mV)

400

200

0

100

T<sub>i</sub> (°C)

200

Fig. 8 V<sub>CEsat</sub> as a function of T<sub>j</sub>; typical values.

Upper graph at I  $_{C}$  = 100 mA; I  $_{B}$  = 10 mA. Lower graph at I  $_{C}$  = 50 mA and I  $_{B}$  = 5 mA.

# SILICON PLANAR EPITAXIAL TRANSISTORS

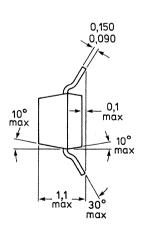
N-P-N silicon transistors, in a microminiature plastic envelope intended for switching and linear applications in thick and thin-film circuits.

### **QUICK REFERENCE DATA**

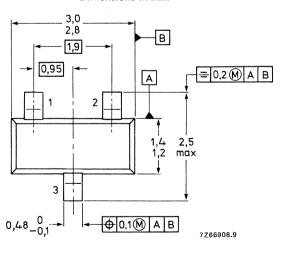
			BSR13	BSR1	4
Collector-base voltage (open emitter)	$V_{\sf CBO}$	max.	60	75	V
Collector-emitter voltage (open base)	$V_{CEO}$	max.	30	40	V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	5	6	V
Collector current (d.c.)	lc	max.		800	mΑ
Total power dissipation up to $T_{amb} = 25$ °C	$P_{tot}$	max.		425	mW
Junction temperature	$T_{j}$	max.		175	oC
D.C. current gain $I_C = 150$ mA; $V_{CE} = 10$ V $I_C = 500$ mA; $V_{CE} = 10$ V	hFE hFE	100 to 300 > 30   40			
Transition frequency at f = 100 MHz $I_C = 20 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	fΤ	>	250	300	MHz

#### **MECHANICAL DATA**

Fig. 1 SOT-23.



### Dimensions in mm



TOP VIEW

# Marking code





BSR13R = U71 BSR14R = U81



R-types are available on request. See also Soldering recommendations. je pra <sub>sod</sub>ejV jš yet Urodd (Am 81 m)

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR13	BSR14	
Collector-base voltage (open emitter) see Fig. 4	$V_{CBO}$	max.	60	75	V
Collector-emitter voltage (open base) see Fig. 4	VCEO	max.	30	40	V
Emitter-base voltage (open collector) see Fig. 4	$v_{EBO}$	max.	5	6	V
Collector current (d.c.)	1 <sub>C</sub>	max.	8	00	mA
Total power dissipation**					
up to $T_{amb} = 25$ °C	$P_{tot}$	max.	4	25	mW
Storage temperature	T <sub>stg</sub>	-	-65 to + 1	75	oC
Junction temperature	$T_{j}$	max.	1	75	оС

### THERMAL CHARACTERISTICS\*

$$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$

### Thermal resistance

From junction to tab	R <sub>th i-t</sub>	=	30	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	260	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=	60	K/W

### CHARACTERISTICS

T<sub>i</sub> = 25 °C unless otherwise specified

Collector cut-off current			BSR13	BSR14	
I <sub>E</sub> = 0; V <sub>CB</sub> = 50 V	Ісво	<	30		nA
$I_E = 0$ ; $V_{CB} = 60 \text{ V}$	СВО	<		10	nΑ
$I_E = 0$ ; $V_{CB} = 50 \text{ V}$ ; $T_i = 150 ^{\circ}\text{C}$	СВО	<	10	-	μΑ
$I_E = 0$ ; $V_{CB} = 60 \text{ V}$ ; $T_i = 150 \text{ °C}$	СВО	<		10	$\mu$ A
$V_{EB} = 3 \text{ V}; V_{CE} = 60 \text{ V}$	ICEX	<		10	nΑ
Base current					
with reverse biased emitter junction					
$V_{EB} = 3 V$ ; $V_{CE} = 60 V$	BEX	< '	-	20	nΑ
Emitter cut-off current					
$I_{C} = 0; V_{EB} = 3 V$	IEBO	<	30	15	nΑ
Saturation voltages ▲					
$I_C = 150 \text{ mA}$ ; $I_B = 15 \text{ mA}$	<b>V</b> CEsat	<	400	300	mV
	VBEsat	<	1300		mV
	VBEsat			0,6 to 1,2	V
$I_C = 500 \text{ mA}; I_B = 50 \text{ mA}$	V <sub>CEsat</sub>	< , , ,	1600	1000	mV
	VBEsat	<	2600	2000	mV

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Device mounted on a ceramic substrate of 15 mm x 15 mm x 0,7 mm.

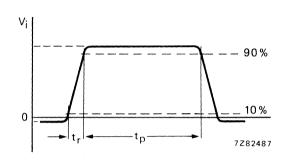
<sup>▲</sup> Measured under pulsed conditions to avoid excessive dissipation  $t_p \le 300 \ μs$ ;  $δ \le 0.02$ .

D.C. current gain * $I_C = 0,1 \text{ mA}; V_{CE} = 10 \text{ V}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ $I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}; V_{CE} = 10 \text{ V}$ $I_C = 150 \text{ mA}; V_{CE} = 1 \text{ V}$ $I_C = 500 \text{ mA}; V_{CE} = 1 \text{ V}$ $I_C = 500 \text{ mA}; V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}; V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}; V_{CE} = 10 \text{ V}$	BSR13; R BSR14; R	hfe hfe hfe hfe hfe hfe	> 35 > 50 > 75 100 to 300 > 50 > 30 > 40	
Transition frequency at f = 100	MHz			
$I_C = 20 \text{ mA}; V_{CE} = 20 \text{ V}$	BSR13; R	fT	> 250	MHz
$I_C = 20 \text{ mA}; V_{CE} = 20 \text{ V}$	BSR14; R	fT	> 300	MHz
Collector capacitance at f = 1 N	Hz			
$I_E = I_e = 0$ ; $V_{CB} = 10 \text{ V}$		$C_c$	< 8	pΕ
h parameters (common emitter)	at f = 1 kHz		BSR14	
input impedance		h <sub>ie</sub>	2 to 8	k $\Omega$
reverse voltage transfer ratio		h <sub>re</sub>	< 8.10-4	
small signal current gain		h <sub>fe</sub>	50 to 300	
output admittance		h <sub>oe</sub>	5 to 35	μS
$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$				
input impedance		h <sub>ie</sub>	0,25 to 1,25	kΩ
reverse voltage transfer ratio		h <sub>re</sub>	< 4.10 <sup>-4</sup>	
small signal current gain		h <sub>fe</sub>	75 to 375	
output admittance		h <sub>oe</sub>	25 to 200	μS

<sup>\*</sup> Measured under pulsed conditions to avoid excessive dissipation; pulse duration  $t_p \le 300~\mu s$ ; duty factor  $\delta \le 0.02$ .

Switching times (between 10% and 90% levels)

Turn-on time switched to I <sub>C</sub> = 150 mA (see Fig. 2)		BSR	14	_
delay time	t <sub>d</sub>	<	10	ns
rise time	tr	<	25	ns
Turn-off time switched from $I_C = 150 \text{ mA}$ (see Fig. 3)				
storage time	ts	< :	225	ns
fall time	t <sub>f</sub>	<	60	ns



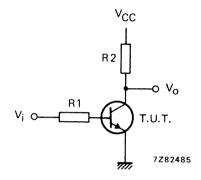


Fig. 2 Waveform and test circuit delay and rise time.

$$V_{i}$$
 =  $-0.5$  to + 9.9 V;  $V_{CC}$  = 30 V; R1 = 619  $\Omega;$  R2 = 200  $\Omega.$ 

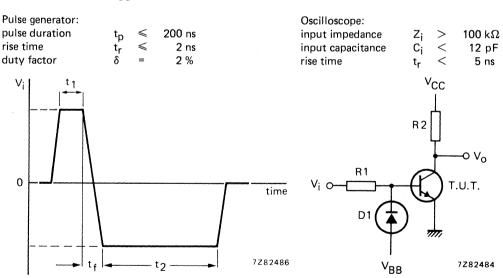
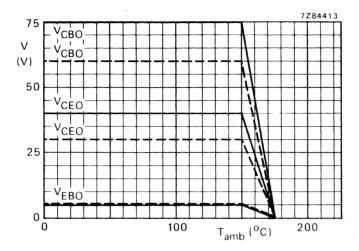


Fig. 3 Waveform and test circuit storage and fall time.

$$V_i$$
 = -13,8 to + 16,2 V;  $V_{CC}$  = 30 V;  $-V_{BB}$  = 3 V; R1 = 1 k $\Omega$ ; R2 = 200  $\Omega$ .

$Z_i$	>	100 k $\Omega$
C;	<	12 pF
t <sub>r</sub>	<	5 ns
	Z <sub>i</sub> C <sub>i</sub> t <sub>r</sub>	$\begin{array}{cc} Z_i & > \\ C_i & < \\ t_r & < \end{array}$



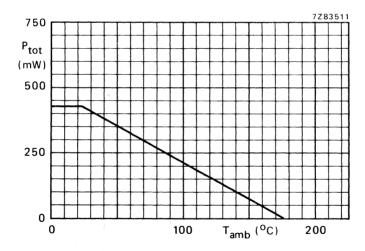


Fig. 5 Power derating curve.

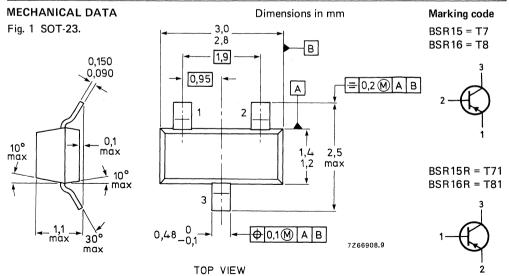


# SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon transistors, in a microminiature plastic envelope, intended for medium power switching and general purpose amplifier applications in thick and thin-film circuits.

## **QUICK REFERENCE DATA**

			BSR15	BSR1	6
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	60	60	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	40	60	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5	V
Collector current (d.c.)	-IC	max.	(	600	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.		425	mW
Junction temperature	Ti	max.		175	oC
D.C. current gain $-I_C = 500 \text{ mA}; -V_{CE} = 10 \text{ V}$	hFE	>	30	50	
Turn-off switching time $-I_{Con} = 150 \text{ mA}; -I_{Bon} = I_{Boff} = 15 \text{ mA}$	<sup>t</sup> off	>		100	ns
Transition frequency at $f = 100 \text{ MHz}$ $-I_C = 50 \text{ mA}; -V_{CE} = 20 \text{ V}$	fΤ	>	:	200	MHz



R-types are available on request.

See also Soldering recommendations.

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Limiting values in accordance with the Absolute Max	imum Syste	in (15	C 134)		
			BSR15	BSR16	
Collector-base voltage (open emitter) See Figs 5 and 6	-V <sub>CBO</sub>	max.	60	60	V
Collector-emitter voltage (open base) See Figs 5 and 6	-VCEO	max.	40	60	$\mathbf{V}_{i}$
Emitter-base voltage (open collector) See Figs 5 and 6 $$	-V <sub>EBO</sub>	max.	5	5	٧
Collector current (d.c.)	$-I_{C}$	max.	6	00	mΑ
Power dissipation up to T <sub>amb</sub> = 25 °C**	$P_{tot}$	max.	4:	25	mW
Storage temperature	T <sub>stg</sub>		-65 to + 1	75	oC
Junction temperature	$T_{j}$	max.	1	75	οС
THERMAL CHARACTERISTICS*					
$T_j = P \times (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab	R <sub>th i-t</sub>	=		30	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	2	60	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	==	ı	60	K/W
CHARACTERISTICS					
T <sub>j</sub> = 25 °C unless otherwise specified					
Collector cut-off current			BSR15	BSR16	
$I_E = 0; -V_{CB} = 50 \text{ V}$	-I <sub>CBO</sub>	<	20	10	nΑ
$I_E = 0; -V_{CB} = 50 \text{ V}; T_j = 150 \text{ °C}$	-I <sub>CBO</sub>	<	20	10	μΑ
$-V_{EB} = 0.5 \text{ V}; -V_{CE} = 30 \text{ V}$	-ICEX	<		50	nΑ
Base current					
with reverse biased emitter junction -V <sub>EB</sub> = 3 V; -V <sub>CE</sub> = 30 V	-I <sub>BEX</sub>	<		50	nΑ
Saturation voltages ▲	DEX				
$-I_C = 150 \text{ mA}; -I_B = 15 \text{ mA}$	−V <sub>CEsat</sub> −V <sub>BEsat</sub>	< <		),4 1,3	V V
$-I_C = 500 \text{ mA}; -I_B = 50 \text{ mA}$	-V <sub>CEsat</sub> -V <sub>BEsat</sub>	<		1,6 2,6	V V

- See Thermal characteristics.
- Device mounted on a ceramic substrate of 15 mm x 15 mm x 0,7 mm.
   Measured under pulsed conditions to avoid excessive dissipation pulse duration t<sub>p</sub> ≤ 300 μs; duty factor δ ≤ 0,02.

D.C. suggest sain *			BSR15	BSR16	
D.C. current gain *				7.5	
$-I_C = 0.1 \text{ mA;} -V_{CE} = 10 \text{ V}$	hFE	>	35	75	
$-I_C = 1 \text{ mA; } -V_{CE} = 10 \text{ V}$	hFE	>	50	100	
$-I_C = 10 \text{ mA}; -V_{CE} = 10 \text{ V}$	hFE	>	75	100	
$-I_C = 150 \text{ mA}; -V_{CE} = 10 \text{ V}$	hFE		100 t	o <b>300</b>	
$-I_C = 500 \text{ mA}; -V_{CE} = 10 \text{ V}$	hFE	>	30	50	
Transition frequency at f = 100 MHz				•	
$-I_C = 50 \text{ mA}; -V_{CE} = 20 \text{ V}; T_{amb} = 25 \text{ °C}$	fΤ	>	20	00	MHz
Collector capacitance at f = 1 MHz					
$I_E = I_e = 0; -V_{CB} = 10 \text{ V}$	$c_c$	<		8	pF
Emitter capacitance at f = 1 MHz					
$I_C = I_c = 0; -V_{EB} = 2 V$	$c_{e}$	<	;	30	рF
Switching times (between 10% and 90% levels)					
Turn-on time when switched to					
$-I_C = 150 \text{ mA}; -I_B = 15 \text{ mA}; \text{ (see Fig. 3)}$					
delay time	t <sub>d</sub>	<	•	10	ns
rise time	t <sub>r</sub>	<	4	10	ns
turn-on time $(t_d + t_r)$	ton	<		<b>1</b> 5	ns
Turn-off time when switched from					
$-I_C = 150 \text{ mA}; -I_B = 15 \text{ mA}$					
to cut-off with + I <sub>BM</sub> = 15 mA (see Fig. 4)					
storage time	t <sub>s</sub>	<	8	30	ns
fall time	t <sub>f</sub>	<	3	30	ns
turn-off time $(t_s + t_f)$	toff	<	10	00	ns

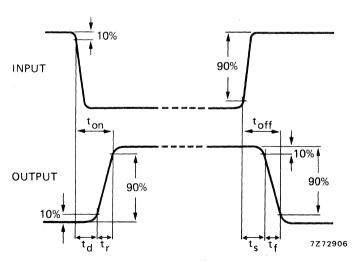


Fig. 2 Switching time waveforms.

<sup>\*</sup> Measured under pulsed conditions to avoid excessive dissipation; pulse duration  $t_p \le 300~\mu s$ ; duty factor  $\delta \le 0.02$ .

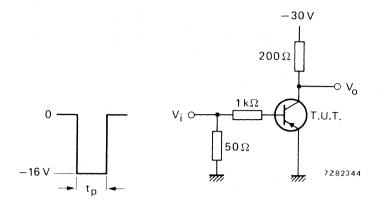


Fig. 3 Turn-on switching time test circuit.

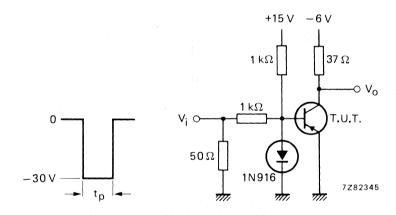


Fig. 4 Turn-off switching time test circuit.

Input pulse generator:	frequency	f	=	150	Hz
Fig. 3 and Fig. 4	pulse duration	tp	=	200	ns
	rise time	tr	<	2	ns
	output impedance	Zo	=	. 50	$\Omega$
Output oscilloscope:	rise time	t <sub>r</sub>	< <	5	ns
Fig. 3 and Fig. 4	input impedance	Zi		10	$\Omega$ M

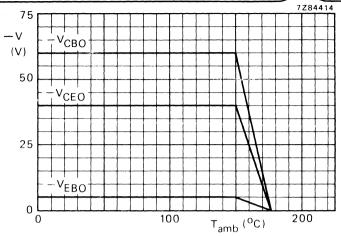
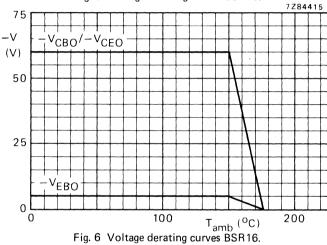


Fig. 5 Voltage derating curves BSR15.



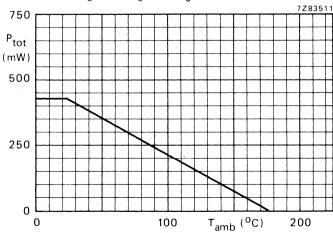


Fig. 7 Power derating curve BSR15; R/BSR16.

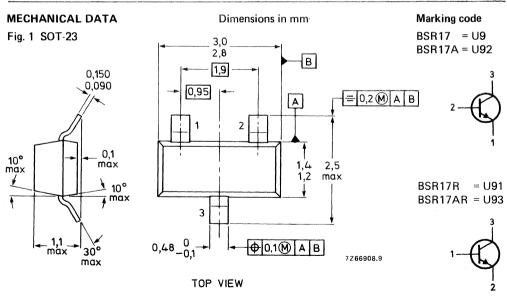


# SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistor in a microminiature plastic envelope intended for switching and linear applications in thick and thin-film circuits.

### QUICK REFERENCE DATA

Collector-base voltage (open emitter)		V <sub>CBO</sub>	max.	60	V
Collector-emitter voltage (open base)		VCEO	max.	40	V
Emitter-base voltage (open collector)		$V_{EBO}$	max.	6	V
Collector current (d.c.)		I <sub>C</sub>	max.	200	mΑ
Total power dissipation up to $T_{amb} = 25$ °C		P <sub>tot</sub>	max.	350	mW
Junction temperature		Ti	max.	150	oC
D.C. current gain		,			
$I_C = 10 \text{ mA; } V_{CE} = 1 \text{ V}$	BSR17	hFE	50 te	o 150	
$I_C = 10 \text{ mA}; V_{CE} = 1 \text{ V}$	BSR17A	hFE	100 t	o <b>300</b>	
Transition frequency at f = 500 MHz					
$I_C = 10 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	BSR17	f <sub>T</sub>	>	250	MHz
$I_C = 10 \text{ mA}; V_{CE} = 20 \text{ V}$	BSR17A	f <sub>T</sub>	>	300	MHz



R-types are available on request. See also *Soldering recommendations*.

# BSR17 BSR17A

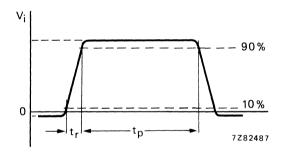
## **RATINGS**

na i ilvus					
Limiting values in accordance with the Absolute	e Maximum System	(IEC 134)			
Collector-base voltage (open emitter)		V <sub>CBO</sub>	max.	60	V
Collector-emitter voltage (open base)		VCEO	max.	40	V
Emitter base voltage (open collector)		$V_{EBO}$	max.	6	٧
Collector current (d.c.)		lc	max.	200	mΑ
Power dissipation up to Tamb = 25 °C**		P <sub>tot</sub>	max.	350	mW
Storage temperature		T <sub>stg</sub>	-55 to +	150	οС
Junction temperature		Tj	max.	150	оС
THERMAL CHARACTERISTICS*					
$T_{j} = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$					
Thermal resistance					
From junction to tab		R <sub>th j-t</sub>	= "	50	K/W
From tab to soldering points		R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**		R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS					
T <sub>j</sub> = 25 °C unless otherwise specified.					
Collector cut-off current					
$I_E = 0$ ; $V_{CB} = 30 \text{ V}$ ; $T_j = 150 ^{\circ}\text{C}$ $V_{FB} = 3 \text{ V}$ ; $V_{CF} = 30 \text{ V}$		СВО	< '		μA nA
Base current		ICEX		50	IIA
with reverse biased emitter junction		•			
$V_{EB} = 3 \text{ V}; V_{CE} = 30 \text{ V}$		<sup>I</sup> BEX	<	50	nA
Saturation voltages <sup>4</sup>					
$I_C = 10 \text{ mA}; I_B = 1 \text{ mA}$		VCEsat	<		mV
$I_C = 50 \text{ mA}; I_B = 5 \text{ mA}$		V <sub>BEsat</sub> V <sub>CEsat</sub>	650 to		m V m V
C 35 m, v, 1B 3 m, v		VBEsat	<		mV
		2.500			
Collector capacitance at $f = 1$ MHz $I_E = I_e = 0$ ; $V_{CB} = 5$ V		C	<	Λ	pF
Emitter capacitance at f = 1 MHz		C <sub>C</sub>		4	þΓ
$I_C = I_c = 0$ ; $V_{EB} = 0.5 \text{ V}$		C <sub>e</sub>	<	8	рF

<sup>▲</sup> Measured under pulsed conditions; pulse duration  $t_p \le 300~\mu s$ ; duty factor  $\delta \le 0.02$ . \* See *Thermal characteristics*.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

D.C. current gain*		B:	SR17	BSR17A	
I <sub>C</sub> = 0,1 mA; V <sub>CE</sub> = 1 V	hFE	>	20	40	
$I_C = 1 \text{ mA; } V_{CE} = 1 \text{ V}$	hFE	>	35	70	
$I_C = 10 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE	> <	50 150	100 300	
$I_C = 50 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE	>	30	60	
$I_C = 100 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE	>	15	30	
Transition frequency at f = 100 MHz $I_C = 10 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	f <sub>T</sub>	>	250	300	MHz
h-parameters (common emitter) $I_C = 1 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $f = 1 \text{ kHz}$					
Input impedance	h <sub>ie</sub>	1 to	8 (	1 to 10	
Reverse voltage transfer ratio	h <sub>re</sub>	0,1 to			10 <sup>-4</sup>
Small-signal current gain	hfe		200	100 to 400	c
Output admittance	h <sub>oe</sub>	1 to	40	1 to 40	μ5
Switching times (between 10% and 90% levels)  Turn on time switched to  IC = 10 mA; I <sub>B</sub> = 1 mA; V <sub>FB</sub> = 0,5 V					
delay time	<sup>t</sup> d		<	35	
rise time	t <sub>r</sub>		<	< 35	ns



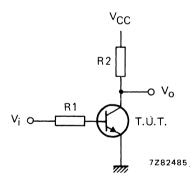


Fig. 2 Delay and rise time equivalent circuit.

$$\begin{split} &V_{j}=-0.5~to+10.6~V;~V_{CC}=3~V;~R1=10~k\Omega;~R2=275~\Omega;\\ &total~shunt~capacitance~of~test~jig~and~connectors=C_{S}\leqslant4~pF.\\ &Pulse~generator:~pulse~duration~300~ns;~fall~time<1~ns;~duty~factor~2\%. \end{split}$$

Turn off time switched from		1	BSR17	BSR17A
$I_C = 10 \text{ mA}$ ; $I_{Bon} = -I_{Boff} = 1 \text{ mA}$ storage time fall time	t <sub>s</sub>		175 50	200 ns 50 ns

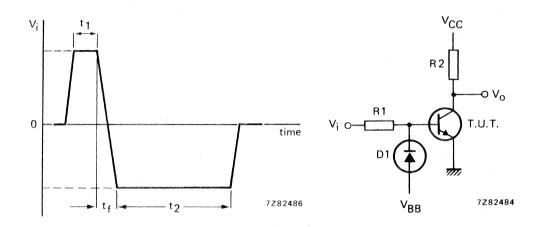


Fig. 3 Storage and fall time equivalent test circuit.

# SILICON LOW-POWER SWITCHING TRANSISTORS

P-N-P silicon transistor in a microminiature plastic envelope, intended for switching and linear applications in thick and thin-film circuits.

### **QUICK REFERENCE DATA**

Collector-base voltage (open emitter)		-V <sub>CBO</sub>	max.	40 V	
Collector-emitter voltage (open base)		-V <sub>CEO</sub>	max.	40 V	
Collector current (d.c.)		IC	max.	200 m	4
Total power dissipation up to T <sub>amb</sub> = 65 °C		$P_{tot}$	max.	250 mV	N
Junction temperature		Ti	max.	150 °C	
D.C. current gain  -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 1 V  -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 1 V	BSR18 BSR18A	hFE hFE	50 to	o 150 o 300	
Transition frequency at f = 500 MHz  -IC = 10 mA; -VCE = 20 V  -IC = 10 mA; -VCE = 20 V	BSR18 BSR18A	f <sub>T</sub> f <sub>T</sub>	> >	200 MH 250 MH	

#### **MECHANICAL DATA** Marking code Dimensions in mm BSR18 Fig. 1 SOT-23: 3,0 = T9 2,8 BSR18A = T92 В 1,9 0,150 0.090 0,95 A 2 0,1 10° max max 1,4 2,5 1,2 max BSR18R = T91 10° BSR18AR = T93 √ max 3 \_1,1 \_max Ф 0,1(M) 30° 7Z66908.9 max TOP VIEW

R-types are available on request. See also *Soldering recommendations*.

Limiting values in accordance with the Absolute Maximu	ım Syster	n (IEC 134)			
Collector-base voltage (open emitter)		-V <sub>CBO</sub>	max.	40	<b>V</b>
Collector-emitter voltage (open base)		-V <sub>CEO</sub>	max.	40	٧
Emitter-base voltage (open collector)		$-V_{EBO}$	max.	5	V
Collector current (d.c.)		-I <sub>C</sub>	max.	200	mΑ
Total power dissipation up to $T_{amb} \le 65$ °C		P <sub>tot</sub>	max.	200	mW
Storage temperature		$T_{stg}$	-55 to	+ 150	oC
Junction temperature		Tj	max.	150	oC
THERMAL CHARACTERISTICS*					
$T_j = Px \left(R_{th j-t} + R_{th t-s} + R_{th s-a}\right) + T_{amb}$					
Thermal resistance					
From junction to tab		R <sub>th j-t</sub>	=	50	K/W
From tab to soldering points		R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**		R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS					
T <sub>amb</sub> = 25 °C unless otherwise specified					
Collector cut-off current					
$I_E = 0; -V_{CB} = 30 \text{ V}$		−Iсво	<	50	nA
Emitter cut-off current I <sub>C</sub> = 0; -V <sub>EB</sub> = 3 V		1	<	50	nA
Saturation voltages A		<sup>−l</sup> EBO		30	шА
-I <sub>C</sub> = 10 mA; -I <sub>B</sub> = 1 mA		−V <sub>CEsat</sub> −V <sub>BEsat</sub>	< 650 t	250 o 850	
$-I_C = 50 \text{ mA}; -I_B = 5 \text{ mA}$		V <sub>CEsat</sub>	<	400	
		$-V_{BEsat}$	<	950	mV
Collector capacitance at $f = 100 \text{ kHz}$ $I_E = I_e = 0$ ; $-V_{CB} = 5 \text{ V}$		C	<	4,5	n.E
Emitter capacitance at f = 100 kHz		C <sub>c</sub>		4,0	ρī ,
$I_C = I_c = 0$ ; $-V_{EB} = 0.5 \text{ V}$		C <sub>e</sub>	<	10	рF

<sup>\*</sup> See Thermal characteristics.

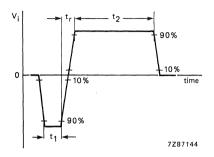
\*\* Mounted on a ceramic substrate of 8 mm  $\times$  10 mm  $\times$  0,7 mm.

A Measured under pulse conditions;  $t_p = 300 \ \mu s$ ;  $\delta = 0,01$ .

D.C. current gain*		BSR18	BSR18A
$-I_C = 0.1 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFF	> 30	60
$-I_C = 1.0 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE ''FE	> 40	80
$-I_C = 10 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFF	50 to 150	100 to 300
$-I_C = 50 \text{ mA}; -V_{CF} = 1 \text{ V}$	hFE	> 30	60
$-1_{C} = 100 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	> 15	30
Transition frequency at f = 100 MHz			
-I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 20 V	$f_T$	> 200	250 MHz
Noise figure at $R_S = 1 k\Omega$			
$-I_C = 100 \mu\text{A}; -V_{CF} = 5 \text{V}$			
f = 10 to 15 700 Hz	F	< 5	4 dB
h parameters (common emitter) at $f = 1 \text{ kHz}$ $-I_C = 1 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$			
input impedance	h <sub>ie</sub>	0,5 to 8	2 to 12 kΩ
reverse voltage transfer ratio		0,1 to 5.10	<sup>4</sup> 1 to 10.10 <sup>-4</sup>
small signal current gain	h <sub>fe</sub>	50 to 200	100 to 400
output admittance	h <sub>oe</sub>	1 to 40	3 to 60 μS
Switching times (between 10% and 90% levels) $-I_C = 10 \text{ mA}$ ; $-I_{Bon} = +I_{Boff} = 1 \text{ mA}$			
delay time	t <sub>d</sub>	<	35 ns
rise time	tr	<	35 ns
0		V <sub>CC</sub>	
V <sub>1</sub> - t <sub>2</sub> 90%	V <sub>i</sub> o———	무.	V <sub>o</sub> т.
<sup>1</sup> 1 → 1 <sup>1</sup> ξ1 ←		777. 728	7143

Fig. 2 Waveform and test circuit delay and rise time.  $V_i$  = +0,5 to -10,6 V; -V<sub>CC</sub> = 3 V; R1 = 10 k $\Omega$ ; R2 = 275  $\Omega$ . Total shunt capacitance of test jig and connectors =  $C_s \le 4$  pF. Pulse generator: pulse duration 300 ns; fall time  $\le$  1 ns; duty factor 2%.

Switching times (between 10% and 90% levels)  $-I_C = 10 \text{ mA}$ ,  $-I_{Bon} = I_{Boff} = 1 \text{ mA}$  storage time fall time



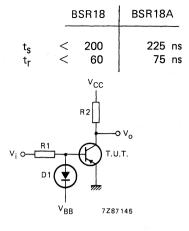


Fig. 3 Waveform and test circuit fall and storage time.

 $V_i = -9.1$  to + 10.9 V;  $V_{CC} = 3$  V;  $V_{BB} = 0$  V (ground); R1 = 10 k $\Omega$ ; R2 = 275  $\Omega$ ; D1 = 1N916.

Total shunt capacitance of test jig and connectors =  $C_s \le 4 pF$ .

Pulse generator: pulse duration  $t_1 = 10$  to 500  $\mu$ s; rise time  $t_r < 1$  ns; duty factor  $\delta = 2\%$ .

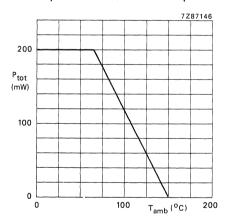


Fig. 4 Power derating curve.

# SILICON N-P-N HIGH-VOLTAGE TRANSISTORS

N-P-N high-voltage small-signal transistors for general purposes and especially telephony applications and encapsulated in a SOT-23 envelope.

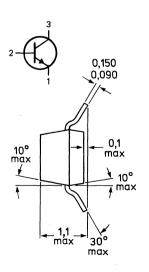
P-N-P complements are BSR20 and BSR20A.

#### **QUICK REFERENCE DATA**

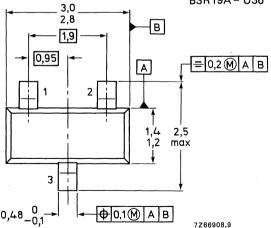
			BSR19	BSR19A
Collector-base voltage (open emitter)	VCBO	max.	160	180 V
Collector-emitter voltage (open base)	VCEO	max.	140	160 V
Collector current	1 <sub>C</sub>	max.	600	600 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350	350 mW
Junction temperature	Тj	max.	150	150 °C
Collector-emitter saturation voltage $I_C = 50 \text{ mA}$ ; $I_B = 5 \text{ mA}$	VCEsat	max.	0,25	0,20 V
D.C. current gain $I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	hFE	min.	60	80

### **MECHANICAL DATA**

Fig. 1 SOT-23.



Dimensions in mm Marking code BSR19 = U35 BSR19A = U36



TOP VIEW

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR19	BSR19A
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	160	180 V
Collector-emitter voltage (open base)	VCEO	max.	140	160 V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	6	V
Collector current	IC	max.	600	mA
Total power dissipation				
up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350	mW
Junction temperature	Тj	max.	150	oC oC
Storage temperature	$T_{stg}$		-65 to +150	oC
Thermal resistance*	R <sub>th j-t</sub>		30	K/W
	R <sub>th t-s</sub>		260	K/W
	R <sub>th s-a</sub>		60	K/W

## **CHARACTERISTICS**

T<sub>amb</sub> = 25 °C unless otherwise specified

			BSR19	BSR19A
Collector cut-off current				
IE = 0; V <sub>CB</sub> = 100 V	ІСВО	max.	100	nA
$I_E = 0$ ; $V_{CB} = 120 \text{ V}$	ICBO	max.		50 nA
I <sub>E</sub> = 0; V <sub>CB</sub> = 100 V; T <sub>amb</sub> = 100 °C	СВО	max.	100	μΑ
I <sub>E</sub> = 0; V <sub>CB</sub> = 120 V; T <sub>amb</sub> = 100 °C	CBO	max.		50 μA
Emitter cut-off current				
$I_C = 0$ ; $V_{EB} = 4.0 \text{ V}$	IEBO	max.	50	50 nA
Breakdown voltages				
$I_C = 1.0 \text{ mA}; I_B = 0$	V(BR)CEO	min.	140	160 V
IC = 100 μA; IE = 0 IC = 0: IE = 10 μA	V(BR)CBO	min.	160	180 V
0 -/ 2 1 1	V(BR)EBO	min.	6,0	6,0 V
Saturation voltages	,		0.15	0.15 \
$I_C = 10 \text{ mA}; I_B = 1,0 \text{ mA}$	VCEsat	max.	0,15	0,15 V 1,0 V
Ic = 50 mA; IB = 5,0 mA	V <sub>BEsat</sub> V <sub>CEsat</sub>	max. max.	1,0 0,25	0,20 V
10 30 mA, 18 = 3,0 mA	V BEsat	max.	1.2	1,0 V
D.C. current gain	DESat		- /-	.,,-
I <sub>C</sub> = 1,0 mA; V <sub>CE</sub> = 5 V	hFF	min.	60	80
C = 10 mA; VCF = 5 V		min.	60	80
IC - 10 IIIA, VCE - 5 V	hFE	max.	250	250
$I_{C} = 50 \text{ mA}; V_{CE} = 5 \text{ V}$	hFE	min.	20	30
Small-signal current gain		min.	50	50
$I_C = 1.0 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $f = 1 \text{ kHz}$	h <sub>fe</sub>	max.	200	200
Output conscitones at f = 1 MHz		max.	200	200
Output capacitance at f = 1 MHz IE = 0; VCB = 10 V	Co	max.	6	6 pF
IE = 0, ACR = 10 A	<b>0</b> 0	illax.	U	O Pr

<sup>\*</sup> Substrate size 15 mm x 15 mm x 0,7 mm.

			BSR19	BSR19A
Input capacitance at f = 1 MHz I <sub>C</sub> = 0; V <sub>EB</sub> = 0,5 V	Ci	max.	30	30 pF
Transition frequency at $f = 100 \text{ MHz}$ I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 10 V	fŢ	min. max.	100 300	100 MHz 300 MHz
Noise figure at R <sub>S</sub> = 1 k $\Omega$ I <sub>C</sub> = 250 $\mu$ A; V <sub>CE</sub> = 5 V; f = 10 Hz to 15,7 kHz	F	max.	10	8 dB

# SILICON P-N-P HIGH-VOLTAGE TRANSISTORS

P-N-P high-voltage small-signal transistors for general purposes and especially in telephony applications and encapsulated in a SOT-23 envelope.

N-P-N complements are BSR19 and BSR19A.

#### **QUICK REFERENCE DATA**

			BSR20	BSR20A
Collector-base boltage (open emitter)	-V <sub>CBO</sub>	max.	130	160 V
Collector-emitter voltage (open base)	-VCEO	max.	120	150 V
Collector current	$-I_{\mathbf{C}}$	max.	600	600 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350	350 mW
Junction temperature	Τj	max.	150	150 °C
Collector-emitter saturation voltage IC = 50 mA; IB = 5 mA	V <sub>CEsat</sub>	max.	0,5	0,5 V
D.C. current gain $I_C = 10 \text{ mA}$ ; $V_{CE} = -5 \text{ V}$	hFE	min.	40	60

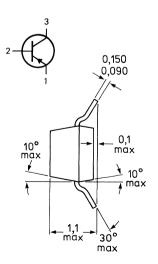
### **MECHANICAL DATA**

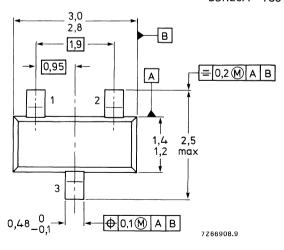
Fig. 1 SOT-23.

Dimensions in mm

### Marking code

BSR20 = T35 BSR20A = T36





TOP VIEW

# BSR20 BSR20A

# **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BSR20	BSR20A
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	130	160 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	120	150 V
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	5	V
Collector current	-IC	max.	600	mA
Total power dissipation				
up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350	mW
Junction temperature	$T_{j}$	max.	150	oC
Storage temperature	$T_{stg}$	-	-65 to +150	°C
Thermal resistance*	R <sub>th j-t</sub>		30	K/W
	R <sub>th t-s</sub>		260	K/W
	R <sub>th s-a</sub>		60	K/W

# CHARACTERISTICS

Tamb = 25 °C unless otherwise specified

			BSR20	BSR20A
Collector cut-off current				
$I_E = 0$ ; $-V_{CB} = 100 \text{ V}$	-ICBO	max.	100	nA
IE = 0; -V <sub>CB</sub> = 120 V	-ICBO	max.		50 nA
I <sub>E</sub> = 0; -V <sub>CB</sub> = 100 V; T <sub>amb</sub> = 100 °C	-ICBO	max.	100	μΑ
$I_E = 0$ ; $-V_{CB} = 120 \text{ V}$ ; $T_{amb} = 100 \text{ °C}$	−lCBO	max.		50 μA
Emitter cut-off current				
$I_C = 0; -V_{EB} = 4,0 V$	-IEBO	max.	50	50 nA
Breakdown voltages				
$I_C = 1.0 \text{ mA}; I_B = 0$	-V(BR)CEO	min.	120	150 V
$I_{C} = 100  \mu A; I_{E} = 0$	-V(BR)CBO	min.	130	160 V
$I_C = 0$ ; $I_E = 10 \mu A$	−V(BR)EBO	min.	5,0	5,0 V
Saturation voltages			•	
$-I_C = 10 \text{ mA}; -I_B = 1,0 \text{ mA}$	-VCEsat	max.	0,2	0,2 V
	$-V_{BEsat}$	max.	1,0	1,0 V
-1C = 50  mA; -1B = 5.0  mA	-VCEsat	max.	0,5	0,5 V
	$-V_{BEsat}$	max.	1,0	1,0 V
D.C. current gain			,	·
$I_C = 1.0 \text{ mA}; -V_{CE} = 5 \text{ V}$	hFE	min.	30	50
$I_C = 10 \text{ mA}; -V_{CF} = 5 \text{ V}$	hFE	min.	40	60
In = 50 m A Van = 5 . V		max.	180	240
$I_{C} = 50 \text{ mA}; -V_{CE} = 5 \text{ V}$	hFE	min.	40	50
Small-signal current gain		min.	30	40
$I_C = 1.0 \text{ mA}; -V_{CE} = 10 \text{ V}; f = 1 \text{ kHz}$	hfe	max.	200	200
Output capacitance at f = 1 MHz				
IF = 0; -VCB = 10 V	Co	max.	6	6 pF
2 00				

<sup>\*</sup> Substrate size 15 mm x 15 mm x 0,7 mm.

			BSR20	BSR20A
Transition frequency at f = 100 MHz $-I_C = 10$ mA; $-V_{CE} = 10$ V	fT	min. max.	100 400	100 MHz 300 MHz
Noise figure at R <sub>S</sub> = 1 k $\Omega$ I <sub>C</sub> = 250 $\mu$ A; -V <sub>CE</sub> = 5 V; f = 10 Hz to 15,7 kHz	F	max.	8	8 dB



# SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in miniature plastic envelopes intended for application in thick and thin-film circuits. They are intended for use in telephony and general industrial applications.

# **QUICK REFERENCE DATA**

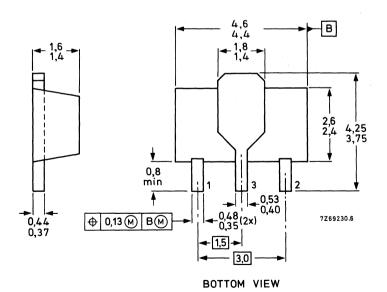
		B	SR30	BSR31	BSR32	BSR33	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	70	70	90	90	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	60	60	80	80	٧
Collector current (d.c.)	-I <sub>C</sub>	max.	1	1	1	1	Α
Total power dissipation up to $T_{amb} = 25$ °C	P <sub>tot</sub>	max.	1	1	1	1	W
Junction temperature	Τį	max.	150	150	150	150	оС
D.C. current gain $-I_C = 100 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	hFE	> <	40 120	100 300	40 120	100 300	
Transition frequency at f = 35 MHz $-I_C = 50 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$	fT	>	100	100	100	100	МН

#### **MECHANICAL DATA**

Dimensions in mm

Mark

Fig. 1 SOT-89.



BSR30 = BR1 BSR31 = BR2 BSR32 = BR3 BSR33 = BR4



See also Soldering recommendations.

# **RATINGS**

		BS	SR30	BSR31	BSR32	BSR33	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	70	70	90	90	<b>V</b>
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	60	60	80	80	٧
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	5	5	5	5	٧
			-				
Collector current (d.c.)	-I <sub>C</sub>	max.			1		Α
Base current (d.c.)	−l <sub>B</sub>	max.			0,1		Α
Total power dissipation up to T <sub>amb</sub> = 25 mounted on a ceramic substrate	оС						
area = $2,5 \text{ cm}^2$ ; thickness = $0,7 \text{ mm}$	P <sub>tot</sub>	max.			1		W
Storage temperature	T <sub>stg</sub>			-65 to +1	150		οС
Junction temperature	Tj	max.		. 1	150		oC
THERMAL RESISTANCE							
From junction to collector tab	R <sub>th j-tab</sub>	=			10		K/W
From junction to ambient in free air mounted on a ceramic substrate	, J						
area = $2,5 \text{ cm}^2$ ; thickness = $0,7 \text{ mm}$	R <sub>th j-a</sub>	=		1	125		K/W

#### **CHARACTERISTICS**

Tamb = 25 °C unless otherwise specified

# Collector cut-off current

$$I_E = 0; -V_{CB} = 60 \text{ V}$$
  $-I_{CBO}$  < 100 nA  
 $I_E = 0; -V_{CB} = 60 \text{ V}; T_i = 150 \text{ °C}$   $-I_{CBO}$  < 50  $\mu$ A

# Breakdown voltages

Breakdown voltages			BSR30	BSR31	BSR32	BSR33		
$I_B = 0$ ; $-I_C = 10 \text{ mA}$	-V <sub>(BR)</sub> CEO	>	60	60	80	80	٧	
$V_{BE} = 0; -I_{C} = 10 \mu A$	-V(BR)CES	>	70	70	90	90	٧	
$I_C = 0; -I_E = 10 \mu\text{A}$	−V(BR)EBO	>	5	5	5	5	٧	
Saturation voltages *								

# Saturation voltages

$$-I_{C} = 150 \text{ mA}; -I_{B} = 15 \text{ mA} \qquad -V_{CEsat} < 0.25 & 0$$

			1	1		
hFE	>	10	30	10	30	
hFE	> <	40 120	100 300	40 120	100 300	
hFE	>	30	50	30	50	
	hFE	h <sub>FE</sub> >	hFE > 40 120	h <sub>FE</sub> > 40 100 300	h <sub>FE</sub> > 40 100 40 120	hFE > 40 100 40 100 120 300 120 300

# Transition frequency at f = 35 MHz

$$-I_C = 50 \text{ mA}; -V_{CE} = 10 \text{ V}$$
 f<sub>T</sub> > 100 MHz

# Collector capacitance at f = 1 MHz

$$I_E = I_e = 0; -V_{CB} = 10 \text{ V}$$
  $C_c$  20 pF

# Emitter capacitance at f = 1 MHz

$$I_C = I_c = 0; -V_{EB} = 0.5 \text{ V}$$
  $C_e$  120 pF

Switching times see next page.

<sup>\*</sup> Measured under pulse conditions:  $t_p$  = 300  $\mu$ s;  $\delta$  < 0,01.

# CHARACTERISTICS (continued)

 $T_{amb} = 25$  °C

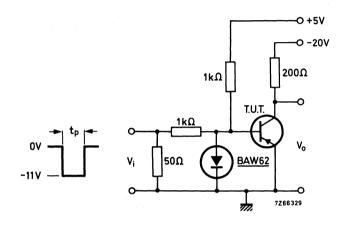
# Switching times

$$-I_{Con} = 100 \text{ mA}; -I_{Bon} = +I_{Boff} = 5 \text{ mA}$$

Turn-on time Turn-off time

500 ns ton 650 ns toff

Test circuit



Pulse generator:

Pulse duration

 $t_p = 10 \,\mu s$  $t_r \leq 15 \text{ ns}$ 

Rise time

Fall time

t<sub>f</sub> ≤15 ns

Source impedance

 $Z_S = 50 \Omega$ 

Oscilloscope:

Rise time

 $t_r \le 15 \text{ ns}$ 

Input impedance

 $Z_I \geqslant 100 \; k\Omega$ 

# SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in miniature plastic envelopes intended for application in thick and thin-film circuits. They are intended for use in telephony and general industrial applications.

# QUICK REFERENCE DATA

		E	SR40	BSR41	BSR42	BSR43	
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	70	70	90	90	٧
Collector-emitter voltage (open base)	$V_{CEO}$	max.	60	60	80	80	٧
Collector current (d.c.)	1 <sub>C</sub>	max.	1	. 1	1	1	Α
Total power dissipation up to $T_{amb} = 25$ °C	$P_{tot}$	max.	1	1	1	1	W
Junction temperature	$T_{j}$	max.	150	150	150	150	oC
D.C. current gain I <sub>C</sub> = 100 mA; V <sub>CE</sub> = 5 V	hFE	> <	40 120	100 300	40 120	100 300	
Transition frequency at f = 35 MHz $I_C = 50$ mA; $V_{CE} = 10$ V	fT	>	100	100	100	100	MF

# MECHANICAL DATA Dimensions in mm Fig. 1 SOT-89. 4.6 4.4 1.8 1.4 1.4 0.48 0.48 0.37 Dimensions in mm A.6 4.6 2.6 2.4 4.25 2.4 3.75 0.48 0.48 0.35 7269230.6

**BOTTOM VIEW** 

Mark

BSR40 = AR1 BSR41 = AR2 BSR42 = AR3 BSR43 = AR4



# BSR40 to 43

# **RATINGS**

		BS	SR40	BSR41	BSR42	BSR43	
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	70	70	90	90	٧
Collector-emitter voltage (open base)	V <sub>CEO</sub>	max.	60	60	80	80	V
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.	5	5	5	5	٧
					1		
Collector current (d.c.)	lC .	max.					Α
Base current (d.c.)	lΒ	max.			0,1		Α
Total power dissipation up to T <sub>amb</sub> = 29 mounted on a ceramic substrate	5 °C						
area = $2.5 \text{ cm}^2$ ; thickness = $0.7 \text{ mm}$	P <sub>tot</sub>	max.			1		W
Storage temperature	T <sub>stg</sub>			-65 to	+150		oC
Junction temperature	Tj	max.			150		oC
THERMAL RESISTANCE							
From junction to collector tab	R <sub>th j-tab</sub>	, =			10		K/W
From junction to ambient in free air mounted on a ceramic substrate							
area = $2.5 \text{ cm}^2$ ; thickness = $0.7 \text{ m}$	R <sub>th j-a</sub>	=			125		K/W

# **CHARACTERISTICS**

T<sub>amb</sub> = 25 °C unless otherwise specified

# Collector cut-off current

Collector cut-off current							
I <sub>E</sub> = 0; V <sub>CB</sub> = 60 V	<sup>I</sup> CBO	<		10	00		nΑ
$I_E = 0$ ; $V_{CB} = 60 \text{ V}$ ; $T_j = 150 ^{\circ}\text{C}$	I <sub>CBO</sub>	<	50			μΑ	
Breakdown voltages			BSR40	BSR41	BSR42	BSR43	
$I_{B} = 0$ ; $I_{C} = 10 \text{ mA}$	V(BR)CEO	>	60	60	80	80	- V
$V_{BF} = 0$ ; $I_{C} = 10 \mu A$	V(BR)CES	>	70	70	90	90	V
$I_C = 0$ ; $I_E = 10 \mu\text{A}$	V <sub>(BR)EBO</sub>	>	5	5	5	5	V
Saturation voltages *							
$I_C = 150 \text{ mA}; I_B = 15 \text{ mA}$	V <sub>CEsat</sub> V <sub>BEsat</sub>	< <	0,25 1,0	0,25 1,0	0,25 1,0	0,25 1,0	V V
$I_C = 500 \text{ mA}$ ; $I_B = 50 \text{ mA}$	V <sub>CEsat</sub> V <sub>BEsat</sub>	< <	0,5 1,2	0,5 1,2	0,5 1,2	0,5 1,2	V V
D.C. current gain *							
$I_C = 100  \mu A;  V_{CE} = 5  V$	hFE	>	10	30	10	30	
$I_C = 100 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	hFE	> <	40 120	100 300	40 120	100 300	
$I_C = 500 \text{ mA}; V_{CE} = 5 \text{ V}$	hFE	>	30	50	30	50	
Transition frequency at f = 35 MHz			·				
$I_C = 50 \text{ mA}; V_{CE} = 10 \text{ V}$	$f_{T}$	>		10	0		MHz
Collector capacitance at f = 1 MHz							
$I_E = I_e = 0; V_{CB} = 10 \text{ V}$	$C_{\mathbf{c}}$	<		1	2		pF
Emitter capacitance at f = 1 MHz							
$I_C = I_c = 0; V_{EB} = 0.5 V$	$C_e$	<		9	0		pF

Switching times see next page.

<sup>\*</sup> Measured under pulse conditions:  $t_p$  = 300  $\mu s;\,\delta <$  0,01.

# **CHARACTERISTICS** (continued)

 $T_{amb} = 25 \, {}^{o}C$ 

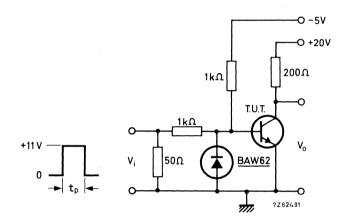
# Switching times

 $I_{Con} = 100 \text{ mA}$ ;  $I_{Bon} = -I_{Boff} = 5 \text{ mA}$ 

Turn-on time

250 ns ton Turn-off time < 1000 ns toff

Test circuit



Pulse generator:

Pulse duration

 $t_p = 10 \,\mu s$ 

Rise time

 $t_r \leq 15 \text{ ns}$ 

Fall time

 $t_f \leq 15 \text{ ns}$ 

Source impedance

 $Z_{\rm S} = 50 \ \Omega$ 

Oscilloscope:

Rise time

 $t_r\leqslant 15 \; \text{ns}$ 

Input impedance

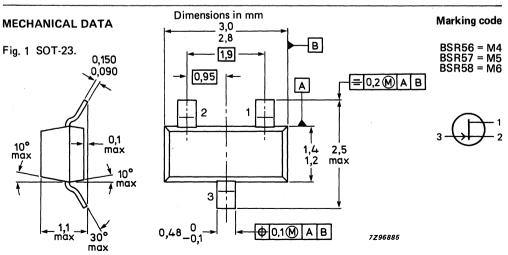
 $Z_I \ge 100 \text{ k}\Omega$ 

# **N-CHANNEL FETS**

Silicon n-channel depletion type junction field-effect transistors in a plastic microminiature envelope intended for application in thick and thin-film circuits. The transistors are intended for low-power, chopper or switching applications in industrial service.

# **QUICK REFERENCE DATA**

		В	SR56	BSR57	BSR58	
Drain-source voltage	±V <sub>DS</sub>	max.	40	40	40	٧
Total power dissipation up to Tamb = 65 °C	P <sub>tot</sub>	max.	250	250	250	mW
Drain current $V_{DS} = 15 \text{ V}; V_{GS} = 0$	IDSS	> <	50 —	20 100	1 -	mA mA
Gate-source cut-off voltage $V_{DS} = 15 \text{ V; } I_D = 0.5 \text{ nA}$	-V <sub>(P)GS</sub>	> <	4 10	2	0,8 4	
Drain-source resistance (on) at $f = 1 \text{ kHz}$ $I_D = 0$ ; $V_{GS} = 0$	<sup>r</sup> ds on	<	25	40	60	Ω
Feedback capacitance at f = 1 MHz -V <sub>GS</sub> = 10 V; V <sub>DS</sub> = 0	C <sub>rs</sub>	<	5	5	5	pF
Turn-off time  VDD = 10 V; VGS = 0	+		25		_	ne
$I_D = 20 \text{ mA}; -V_{GSM} = 10 \text{ V}$ $I_D = 10 \text{ mA}; -V_{GSM} = 6 \text{ V}$ $I_D = 5 \text{ mA}; -V_{GSM} = 4 \text{ V}$	<sup>t</sup> off <sup>t</sup> off <sup>t</sup> off	< <	_ _ _	50 -		ns ns ns



See also Soldering Recommendations. TOP VIEW

RATINGS						
Limiting values in accordance with the Absolute	e Maximum Sy	stem	(IEC 134)			
Drain-source voltage (See Fig. 4)		. :	V <sub>DS</sub>	max.	40	V
Drain-gate voltage (See Fig. 4)			√DGO	max.	40	V
Gate-source voltage (See Fig. 4)			-V <sub>GSO</sub>	max.	40	V
Forward gate current			GF	max.	50	mΑ
Total power dissipation up to T <sub>amb</sub> = 65 °C			tot	max.	250	mW
Storage temperature range			Γ <sub>stg</sub>	55 t	to + 175	οС
Junction temperature			Гј	max.	175	оС
THERMAL CHARACTERISTICS*						
$T_{j} = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$						
Thermal resistance						
From junction to tab		1	R <sub>th j-t</sub>	= -	60	K/W
From tab to soldering points			Rth t-s	=	280	K/W
From soldering points to ambient**			Rth s-a	=	90	K/W
CHARACTERISTICS						
T <sub>amb</sub> = 25 °C unless otherwise specified						
Gate-source cut-off current						
$V_{DS} = 0 \text{ V}; -V_{GS} = 20 \text{ V}$	-I <sub>GSS</sub>	<		1		nΑ
Drain cut-off current		_		4		А
$V_{DS} = 15 \text{ V}; -V_{GS} = 10 \text{ V}$	IDSX	<		1		nA
			BSR56	BSR57	BSR58	_
Drain current ▲						
V <sub>DS</sub> = 15 V; V <sub>GS</sub> = 0	IDSS	>	50	20	1	mA mA
Gate-source breakdown voltage			<del></del>	100	80	mA
$-I_G = 1 \mu A; V_{DS} = 0$	-V(BR)GSS	>	40	40	40	V
Gate-source cut-off voltage		>	4	2	0,8	V
$I_D = 0.5 \text{ nA; } V_{DS} = 15 \text{ V}$	−V(P)GS	<	10	6	, ,	V
Drain-source voltage (on)						
I <sub>D</sub> = 20 mA; V <sub>GS</sub> = 0	V <sub>D</sub> Son	< <	750	- 500	_	mV mV
$I_D = 10 \text{ mA; } V_{GS} = 0$ $I_D = 5 \text{ mA; } V_{GS} = 0$	V <sub>DSon</sub> V <sub>DSon</sub>	<	_	-	400	m v mV
ν <u>αυ</u> -	DOON			1	1	

<sup>r</sup>ds on

Drain-source resistance (on) at f = 1 kHz

 $I_D = 0; V_{GS} = 0$ 

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm. Measured under pulsed conditions;  $t_p = 100$  ms;  $\delta \le 0,1$ .

			BSR56	BSR57	BSR58
Switching times* $V_{DD} = 10 \text{ V}; V_{GS} = 0$ Conditions $I_D$ and $-V_{GSM}$	I <sub>D</sub>	=	20 10	10	5 mA 4 V
	$-V_{GSM}$	_	10	0	4 V
Delay time	<sup>t</sup> d	<	6	6	10 ns
Rise time	t <sub>r</sub>	<	3	4	10 ns
Turn-off time	t <sub>off</sub>	<	25	50	100 ns

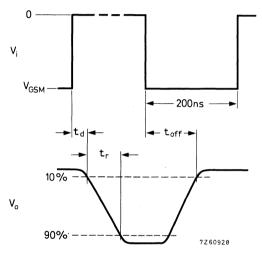


Fig. 2 Switching times waveforms.

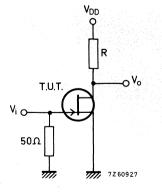


Fig. 3 Test circuit.

BSR56; R = 464  $\Omega$ BSR57; R = 953  $\Omega$ BSR58; R = 1910  $\Omega$ 

# Pulse generator

 $t_r = t_f \le 1 \text{ ns}$   $\delta = 0.02$  $Z_0 = 50 \Omega$ 

# Oscilloscope

 $\begin{array}{l} t_r \leqslant 0.75 \text{ ns} \\ R_i \geqslant \quad 1 \text{ M}\Omega \\ C_i \leqslant \quad 2.5 \text{ pF} \end{array}$ 

<sup>\*</sup> Switching times measured on devices in SOT-18 envelope.

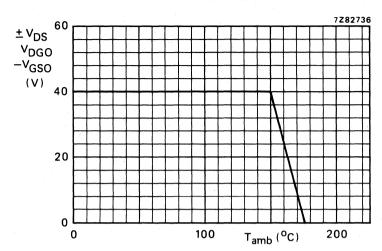


Fig. 4 Voltage derating curve.

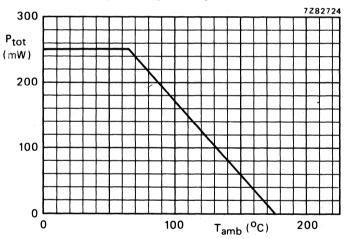


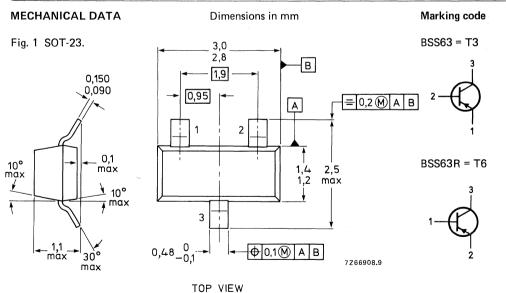
Fig. 5 Power derating curve.

# HIGH VOLTAGE P-N-P TRANSISTORS

Silicon planar epitaxial transistor in a microminiature plastic envelope intended for application in thick and thin-film circuits. This transistor is intended for high voltage general purpose and switching applications.

# QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	110 V
Collector-emitter voltage (open base)	-VCEO	max.	100 V
Collector current (peak value)	−l CM	max.	100 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350 mW
Junction temperature	$T_{j}$	max.	175 °C
D.C. current gain at $T_j = 25$ °C $-I_C = 25$ mA; $-V_{CE} = 5$ V	hFE	>	30
Transition frequency at $f = 35 \text{ MHz}$ $-1_C = 25 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	fŢ	> typ.	50 MHz 85 MHz



R-types are available on request

See also Soldering recommendations.

# **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC	134)			
Collector-base voltage (open emitter) see Fig. 6 $-I_C = 10 \mu\text{A}$	-V <sub>CBO</sub>	max.	110	V
Collector-emitter voltage (open base) see Fig. 6 $-I_C = 100 \mu\text{A}$	-V <sub>CEO</sub>	max.	100	٧
Emitter-base voltage (open collector) see Fig. 6 $-I_E = 10 \mu A$	-V <sub>EBO</sub>	max.	6	٧
Collector current (d.c.)	-IC	max.	100	mΑ
Collector current (peak value)	-I <sub>CM</sub>	max.	100	mΑ
Base current (peak value)	-I <sub>BM</sub>	max.	100	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C **	P <sub>tot</sub>	max.	350	mW
Storage temperature		65 to +	175	оС
Junction temperature	T <sub>j</sub>		175	
THERMAL CHARACTERISTICS *				
$T_{j} = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th i-t</sub>	=	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient **	R <sub>th s-a</sub>	= '	90	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Collector cut-off current I <sub>E</sub> = 0; -V <sub>CB</sub> = 90 V	-I <sub>CBO</sub>	<	100	nA
$I_E = 0; -V_{CB} = 90 \text{ V}; T_j = 150 ^{\circ}\text{C}$	-I <sub>CBO</sub>	< 1	50	μΑ
Emitter cut-off current I <sub>C</sub> = 0; -V <sub>EB</sub> = 6 V	-I <sub>EBO</sub>	<	200	nA
Saturation voltage $-I_C = 25 \text{ mA}$ ; $-I_B = 2.5 \text{ mA}$	−V <sub>CEsat</sub> −V <sub>BEsat</sub>	< <	250 900	
D.C. current gain	DESGL			
$-I_C = 10 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	>	30	
$-I_C = 25 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	>	30	
Collector capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0$ ; $-V_{CB} = 10 \text{ V}$	C <sub>C</sub>	typ.	3	pF

typ.

50 MHz

85 MHz

Transition frequency at f = 35 MHz

 $-I_C = 25 \text{ mA}; -V_{CE} = 5 \text{ V}$ 

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

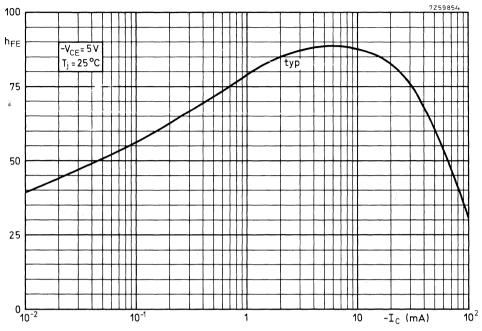


Fig. 2.

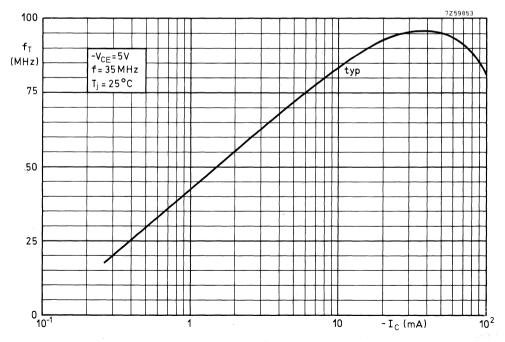


Fig. 3.

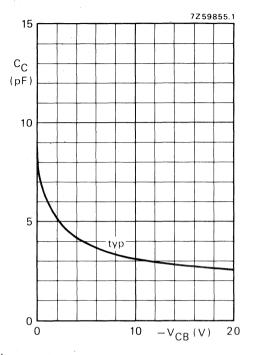


Fig. 4 Typical values collector capacitance as a function of collector-base voltage.  $I_E = I_e = 0$ ;  $T_j = 25$  °C; f = 1 MHz.

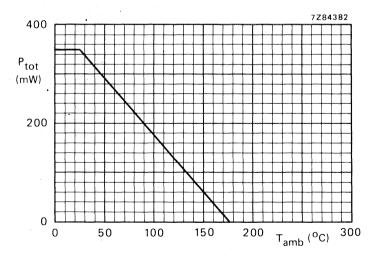


Fig. 5 Power derating curve.

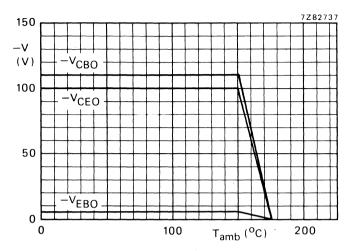


Fig. 6 Voltage derating curves.

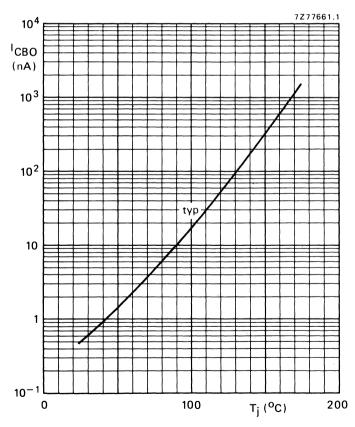


Fig. 7 Typical values collector-base currents as a function of the junction temperature at a collector-base voltage of 90 V.

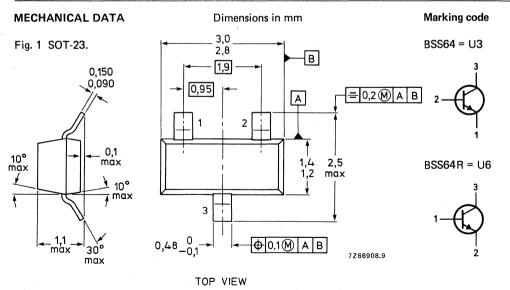


# HIGH VOLTAGE N-P-N TRANSISTORS

Silicon planar epitaxial transistor in a microminiature plastic envelope intended for application in thick and thin-film circuits. This transistor is intended for high-voltage general purpose and switching applications.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	120 V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	80 V
Collector current (peak value)	<sup>I</sup> CM	max.	250 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350 mW
Junction temperature	Τ <sub>j</sub>	max.	175 °C
D.C. current gain $I_C = 10 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$ ; $T_i = 25  {}^{\circ}\text{C}$	hFE	> typ.	20 80
Transition frequency at f = 35 MHz I <sub>C</sub> = 4 mA; V <sub>CE</sub> = 10 V	fT	>	60 MHz
Turn-off time $I_C = 15 \text{ mA}$ ; $I_{Bon} = -I_{Boff} = 1 \text{ mA}$	t <sub>off</sub>	<	1 μs



R-types are available on request

See also Soldering recommendations.

RATINGS				
Limiting values in accordance with the Absolute Maximum Syster	m (IEC 134)			
Collector-base voltage (open emitter) see Fig. 2 $I_C = 100 \mu A$	V <sub>CBO</sub>	max.	120	V
Collector-emitter voltage (open base) see Fig. 2 $I_C = 4 \text{ mA}$	V <sub>CEO</sub>	max.	80	V
Emitter-base voltage (open collector) see Fig. 2 $I_E = 100 \mu A$	V <sub>EBO</sub>	max.	5	٧
Collector current (d.c. or averaged over any 20 ms period)	<sup>1</sup> C	max.	100	mΑ
Collector current (peak value)	ICM	max.	250	
Base current (peak value)	IBM	max.	100	
Total power dissipation up to T <sub>amb</sub> = 25 °C **	P <sub>tot</sub>	max.	350	
Storage temperature	T <sub>sta</sub>	-65 to		
Junction temperature	T <sub>i</sub>	max.	175	
	· J			
THERMAL CHARACTERISTICS *				
$T_{j} = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	=	50	K/W
From tab to soldering points	R <sub>th t-s</sub>	=,	280	K/W
From soldering points to ambient **	R <sub>th s-a</sub>	=	90	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Collector cut-off current $I_E = 0$ ; $V_{CB} = 90 \text{ V}$	ІСВО	<	100	nA
I <sub>E</sub> = 0; V <sub>CB</sub> = 90 V; T <sub>i</sub> = 150 °C	Ісво	<	50	μΑ
Emitter cut-off current I <sub>C</sub> = 0; V <sub>EB</sub> = 5 V	I <sub>EBO</sub>	typ.	0,5 200	nA
Saturation voltages			200	nA
$I_C = 4 \text{ mA}$ ; $I_B = 400 \mu \text{A}$	V <sub>CEsat</sub>	<	150 1200	mV mV

 $\begin{matrix} v_{\text{CEsat}} \\ v_{\text{BEsat}} \end{matrix}$ 

 $\mathsf{v}_{\mathsf{CEsat}}$ 

typ.

typ.

typ.

hFE

hFE

hFE

150 mV 1200 mV

200 mV

60

20

80

55

 $I_C = 50 \text{ mA}; I_B = 15 \text{ mA}$ 

 $I_C = 1 \text{ mA}$ ;  $V_{CE} = 1 \text{ V}$ 

 $I_C = 10 \text{ mA}$ ;  $V_{CE} = 1 \text{ V}$ 

 $I_C = 20 \text{ mA}; V_{CE} = 1 \text{ V}$ 

D.C. current gain

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Transition frequency at f = 35 MHz 
$$I_{C} = 4$$
 mA;  $V_{CE} = 10$  V  $f_{T}$   $f$ 

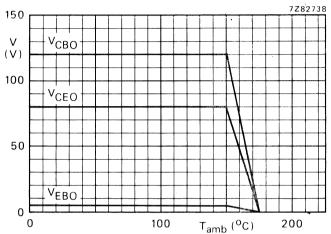


Fig. 2 Voltage derating curves.

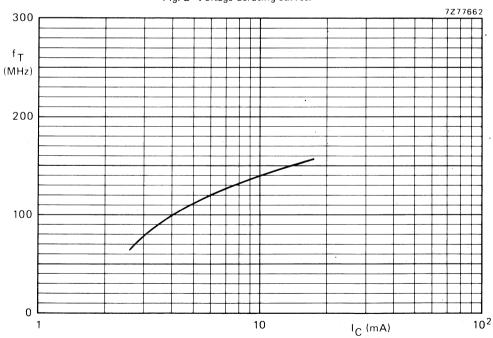


Fig. 3 Typical values transition frequency.  $V_{CE} = 10 \text{ V}$ ; f = 35 MHz;  $T_i = 25 \text{ }^{\circ}\text{C}$ .

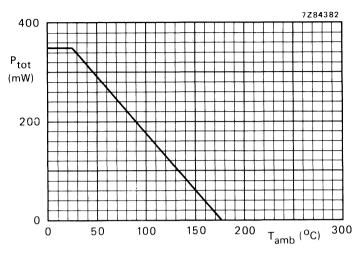


Fig. 4 Power derating curve.

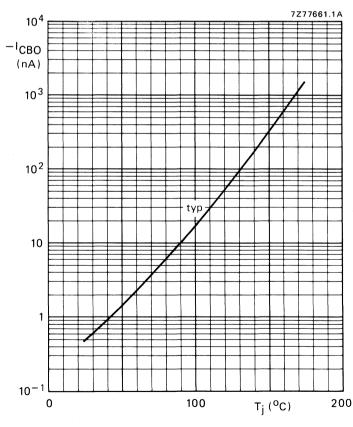


Fig. 5 Typical values collector-base current as a function of the junction temperature at a collector-base voltage of  $-90\ V.$ 

# MOSFET N-CHANNEL ENHANCEMENT SWITCHING TRANSISTOR

Symmetrical insulated-gate silicon MOS field-effect transistor of the N-channel enhancement mode type.

The transistor is sealed in a SOT-143 envelope and features a low ON resistance and low capacitances.

The transistor is protected against excessive input voltages by integrated back-to-back diodes between gate and substrate.

# Applications:

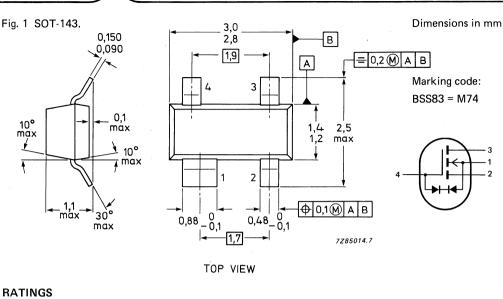
- analog and/or digital switch
- switch driver

#### QUICK REFERENCE DATA

Drain-source voltage	$V_{DS}$	max.	10	V
Source-drain voltage	$V_{SD}$	max.	10	V
Drain-substrate voltage	$V_{DB}$	max.	15	V
Source-substrate voltage	$V_{SB}$	max.	15	V
Drain current (d.c.)	I <sub>D</sub>	max.	50	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	230	mW
Gate-source cut-off voltage $V_{DS} = V_{GS}$ ; $V_{SB} = 0$ ; $I_D = 1 \mu A$	V <sub>(P)GS</sub>	> <	0,1 2,0	
Drain-source ON-resistance $V_{GS} = 10 \text{ V}; V_{SB} = 0; I_D = 0,1 \text{ mA}$	R <sub>DS(on)</sub>	<	45	Ω
Feed-back capacitance $V_{GS} = V_{BS} = -15 \text{ V};$ $V_{DS} = 10 \text{ V}; f = 1 \text{ MHz}$	C <sub>rss</sub>	typ.	0,6	pF

# **MECHANICAL DATA**

SOT-143 (see Fig. 1).



RA	TII	NGS
----	-----	-----

•			
Drain-source voltage	$V_{DS}$	max.	10 V
Source-drain voltage	$v_{SD}$	max.	10 V
Drain-substrate voltage	$v_{DB}$	max.	15 V
Source-substrate voltage	$V_{SB}$	max.	15 V
Drain current (d.c.)	I <sub>D</sub>	max.	50 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C*	$P_{tot}$	max.	230 mW*
Storage temperature range	$T_{stg}$	-65 to	+ 150 °C
Junction temperature	Tj	max.	125 °C
THERMAL RESISTANCE			
From junction to ambient in free air*	R <sub>th j-a</sub>	=	430 K/W*
CHARACTERISTICS			
T <sub>amb</sub> = 25 °C unless otherwise specified			
Drain-source breakdown voltage $V_{GS} = V_{BS} = -5 \text{ V}; I_D = 10 \text{ nA}$	V <sub>(BR)DSX</sub>	>	10 V
Source-drain breakdown voltage V <sub>GD</sub> = V <sub>BD</sub> = -5 V; I <sub>D</sub> = 10 nA	V <sub>(BR)SDX</sub>	>	10 V
Drain-substrate breakdown voltage  VDB = 0; ID = 10 nA; open source	V <sub>(BR)DBO</sub>	> 1	15 V
Source-substrate breakdown voltage  VDB = 0; ID = 10 nA; open drain	V <sub>(BR)</sub> SBO	>	15 V
Drain-source leakage current $V_{GS} = V_{BS} = -2 \text{ V}; V_{DS} = 6,6 \text{ V}$	<sup>I</sup> DSoff	<	10 nA
1			

Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Source-drain leakage current $V_{GD} = V_{BD} = -2 \text{ V}; V_{SD} = 6,6 \text{ V}$ Forward transconductance at f = 1 kHz $V_{DS} = 10 \text{ V}; V_{SB} = 0; I_D = 20 \text{ mA}$	<sup>I</sup> SDoff <sup>9</sup> fs	< > typ.	10 nA 10 mS 15 mS	•
Gate-source cut-off voltage $V_{DS} = V_{GS}$ ; $V_{SB} = 0$ ; $I_{D} = 1 \mu A$ Drain-source ON-resistance $I_{D} = 0.1 \text{ mA}$ ;	V <sub>(P)GS</sub>	> <	0,1 V 2,0 V	
$V_{GS} = 5 \text{ V}; V_{SB} = 0$ $V_{GS} = 10 \text{ V}; V_{SB} = 0$	R <sub>DS(on)</sub>	< < typ.	70 Ω 45 Ω 80 Ω	
$V_{GS} = 3.2 \text{ V}; V_{SB} = 6.8 \text{ V (see Fig. 4)}$ Gate-substrate zener voltages $V_{DB} = V_{SB} = 0; -I_C = 10 \mu A$	R <sub>DS(on)</sub>	>	120 Ω 12,5 V	
$V_{DB} = V_{SB} = 0$ ; + $I_G = 10 \mu A$ Capacitances at f = 1 MHz $V_{GS} = V_{BS} = -15 V$ ; $V_{DS} = 10 V$	V <sub>Z(2)</sub>	>	12,5 V	
Feed-back capacitance Input capacitance	C <sub>rss</sub> C <sub>iss</sub>	typ. typ.	0,6 pF 1,5 pF	
Output capacitance Switching times (see Fig. 2)	C <sub>OSS</sub>	typ.	1,0 pF	
$V_{DD} = 10 \text{ V}; V_i = 5 \text{ V}$	<sup>t</sup> on <sup>t</sup> off	typ. typ.	1,0 ns 5,0 ns	

# Pulse generator:

 $\begin{array}{lll} R_i & = & 50 \ \Omega \\ t_r & < & 0.5 \ ns \\ t_f & < & 1.0 \ ns \\ t_p & = & 20 \ ns \\ \delta & < & 0.01 \end{array}$ 

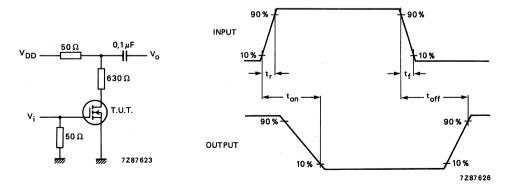


Fig. 2 Switching times test circuit and input and output waveforms.

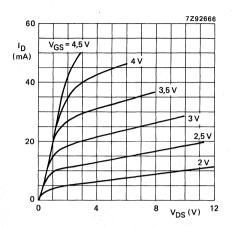


Fig. 3  $V_{SB} = 0$ ; typical values.

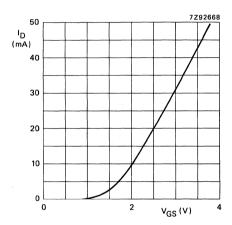


Fig. 5  $V_{DS} = 10 \text{ V}$ ;  $V_{BS} = 0$ ; typical values.

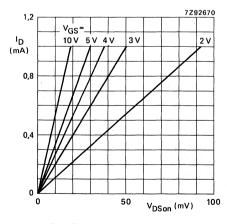


Fig. 7  $V_{SB} = 0$ ; typical values.

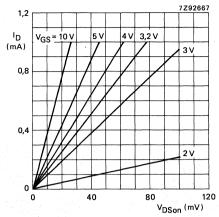


Fig. 4  $V_{SB} = 6.8 \text{ V}$ ; typical values.

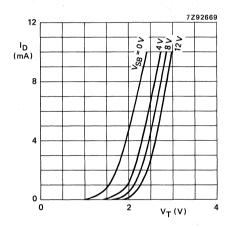


Fig. 6  $V_{DS} = V_{GS} = V_{T}$ .

Conditions for Figs 3, 4, 5, 6 and 7:  $T_j = 25$  °C.

# SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in miniature plastic envelopes intended for use in amplifier and switching applications. Complementary types are BST39/40.

# QUICK REFERENCE DATA

		В	ST15	BST16	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	200	350	V
Collector-emitter voltage (open base)	−V <sub>CEO</sub>	max.	200	300	٧
Collector current (d.c.)	$-I_{C}$	max.		1	Α
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.		1	W
Junction temperature	$T_{j}$	max.	15	0	оС
D.C. current gain $-V_{CE} = 10 \text{ V}; -I_{C} = 50 \text{ mA}$	hFE	30 to	o 150	30 to 120	
Transition frequency -V <sub>CE</sub> = 10 V; -I <sub>C</sub> = 10 mA	f <sub>T</sub>	>	1	5	МН

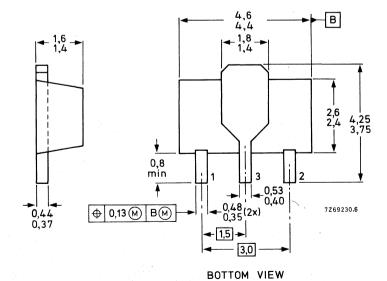
# **MECHANICAL DATA**

Fig. 1 SOT-89.

# Dimensions in mm

**BST15 = BT1 BST16 = BT2** 

Marking:





See also Soldering Recommendations

# **RATINGS**

		В	ST15	В	ST16	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	200		350	V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	200		300	V
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.	4		6	٧
Collector current (d.c.)	-IC	max.		1		Α
Base current	$-I_{\mathbf{B}}$	max.		0,5		Α
Total power dissipation up to Tamb = 25 °C*	P <sub>tot</sub>	max.		1		W
Junction temperature	т <sub>ј</sub>	max.		150		οС
Storage temperature	T <sub>stg</sub>		65	to 15	0	οС
THERMAL RESISTANCE						
from junction to ambient*	R <sub>th j-mb</sub>	= ,		125		K/W
from junction to collector tab	R <sub>th j-tab</sub>	=		10		K/W
CHARACTERISTICS						
T <sub>i</sub> = 25 °C unless otherwise specified			0745		0740	
Collector cut-off current			ST15	R	ST16	·
I <sub>E</sub> = 0; -V <sub>CB</sub> = 175 V	-I <sub>CBO</sub>	<	1		_	μΑ
$I_E = 0; -V_{CB} = 280 \text{ V}$	-Ісво	<			1	μΑ
$I_B = 0; -V_{CE} = 150 \text{ V}$	-ICEO	< <	50		_	μΑ
I <sub>B</sub> = 0; -V <sub>CE</sub> = 250 V	-ICEO	<	_		50	μΑ
Emitter cut-off current I <sub>C</sub> = 0; -V <sub>EB</sub> = 4 V	1550	<	20			μA
$I_{C} = 0; -V_{EB} = 6 \text{ V}$	−l <sub>EBO</sub> −l <sub>EBO</sub>	<	_			μΑ
Collector-emitter breakdown voltage	LBO					
$I_B = 0$ ; $-I_C = 50 \text{ mA}$ ; $L = 25 \text{ mH}$	-V(BR)CEO	>	200		300	٧
Collector-emitter saturation voltage						
$-I_C = 50 \text{ mA}; -I_B = 5 \text{ mA}$	-V <sub>CEsat</sub>	<	2,5		2,0	٧
D.C. current gain -V <sub>CF</sub> = 10 V; -I <sub>C</sub> = 50 mA	hFE	30 t	o 150	30 to	o 120	
Transition frequency at f = 30 MHz				1		
-I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 10 V	f <sub>T</sub>	>		15		МН
Collector capacitance at f = 1 MHz						
$I_E = I_e = 0; -V_{CB} = 10 \text{ V}$	C <sub>c</sub>	<		15		рF

<sup>\*</sup> Mounted on an area of 2,5 cm<sup>2</sup> of a ceramic substrate; thickness 0,7 mm.

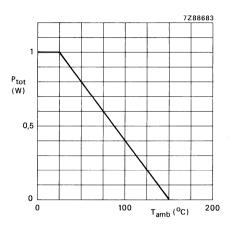


Fig. 2 Power derating curve.



# SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in miniature plastic envelopes intended for use in amplifier and switching applications. Complementary p-n-p types are BST15/16.

# **QUICK REFERENCE DATA**

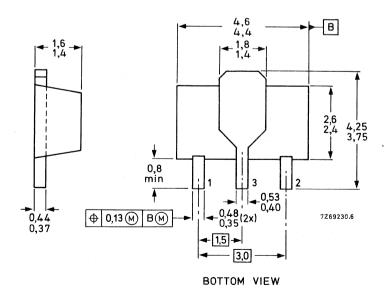
			BST39	BST4	)
Collector-base voltage (open emitter)	$v_{CBO}$	max.	400	300	V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	350	250	٧
Collector current (d.c.)	Ic	max.		1	Α
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.		1	W
Junction temperature	Τj	max.	1	50	оС
D.C. current gain $V_{CE} = 10 \text{ V; } I_C = 20 \text{ mA}$	h <sub>FE</sub>	min.		40	
Transition frequency at $f = 5 \text{ MHz}$ $V_{CE} = 10 \text{ V}$ ; $I_{C} = 10 \text{ mA}$	f <sub>T</sub>	min.		70	MHz

#### **MECHANICAL DATA**

Fig. 1 SOT-89.

Dimensions in mm

Marking BST39 = AT1 BST40 = AT2





See also Soldering Recommendations.

**RATINGS** 

_				BST39   BST40	
	Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	400 300	V
	Collector-emitter voltage (open base)	VCEO	max.	350 250	٧
	Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.	5	V
	Collector current (d.c.)	IC	max.	1	Α
	Base current	I <sub>B</sub>	max.	0,5	Α
	Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	1	W
	Junction temperature	Tį	max.	150	οС
	Storage temperature	T <sub>stg</sub>		-65 to 150	oC
	THERMAL RESISTANCE				
	from junction to ambient*	R <sub>th j-a</sub>	=	125	K/W
	CHARACTERISTICS				
	T <sub>j</sub> = 25 °C unless otherwise specified				
	Collector cut-off current I <sub>B</sub> = 0; V <sub>CE</sub> = 300 V	<sup>I</sup> СВО	<b>«</b>	20	nA
	Emitter cut-off current I <sub>C</sub> = 0; V <sub>EB</sub> = 5 V	<sup>I</sup> EBO	€	10	μΑ
	Collector-emitter saturation voltage $I_C = 50 \text{ mA}$ ; $I_B = 4 \text{ mA}$	VCEsat	€	0,5	V
	Base-emitter saturation voltage $I_C = 50 \text{ mA}$ ; $I_B = 4 \text{ mA}$	V <sub>BEsat</sub>		1,3	V
	D.C. current gain V <sub>CE</sub> = 10 V; I <sub>C</sub> = 20 mA	hFE	€	40	
	Collector capacitance at $f = 1 \text{ MHz}$ $I_E = i_e = 0$ ; $V_{CB} = 10 \text{ V}$	C <sub>c</sub>	<b>«</b>	2	pF
	Emitter capacitance at $f = 1 \text{ MHz}$ $I_C = I_c = 0$ ; $V_{EB} = 5 \text{ V}$	C <sub>e</sub>	<b>«</b>	20	pF
	Transition frequency at $f = 5 \text{ MHz}$ $V_{CE} = 10 \text{ V}$ ; $I_{C} = 10 \text{ mA}$	f <sub>T</sub>	≽	70	MHz

<sup>\*</sup> Mounted on an area of 2,5 cm² of a ceramic substrate; thickness 0,7 mm.

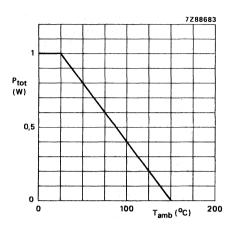


Fig. 2 Power derating curve.

## N-P-N SILICON PLANAR DARLINGTON TRANSISTORS

Silicon n-p-n planar Darlington transistors for industrial switching applications, e.g. print hammer, solenoid, relay and lamp driving. Encapsulated in a microminiature SOT-89 envelope. P-N-P complements are BST60, 61, 62 respectively.

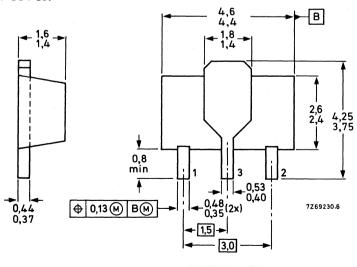
## **QUICK REFERENCE DATA**

		BST50	BST51	BST52
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max. 60	80	90 V
Collector-emitter voltage	V <sub>CER</sub>	max. 45	60	80 V
Collector current	IC	max. 0,5	0,5	0,5 A
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	1	w
D.C. current gain I <sub>C</sub> = 500 mA; V <sub>CE</sub> = 10 V	hFE	>	2000	
Collector-emitter saturation voltage I <sub>C</sub> = 500 mA; I <sub>B</sub> = 0,5 mA	V <sub>CEsat</sub>	<	1,3	V
Turn-off time $I_C = 500 \text{ mA}$ ; $I_{Bon} = -I_{Boff} = 0.5 \text{ mA}$	<sup>t</sup> off	typ.	1500	ns

Dimensions in mm

#### **MECHANICAL DATA**

Fig. 1 SOT-89.



Mark

BST50 = AS1 BST51 = AS2 BST52 = AS3

BOTTOM VIEW

See also Soldering recommendations.

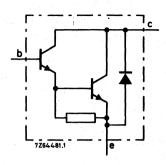


Fig. 2 Circuit diagram.

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BST50	BST51	BST	52	
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	60	80	90	V	
Collector-emitter voltage*	VCER	max.	45	60	80	V	
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.		5		V	
Collector current (d.c.)	Ic	max.		0,5		Α	
Collector current (peak)	ICM	max.		1,5		Α	
Base current (d.c.)	IB	max.		0,1		Α	
Total power dissipation▲ up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.		1		W	
Storage temperature	T <sub>stg</sub>			-65 to + 1	150	oC	
Junction temperature **	$T_{j}$	max.		150		oC	
THERMAL RESISTANCE**							
From junction to ambient▲	R <sub>th j-a</sub>	-		125		K/W	٧
From junction to tab	R <sub>th j-tab</sub>	=		10		K/W	V

External  $R_{BE}$  not to exceed value shown in Fig. 5. Based on maximum average junction temperature in line with common industrial practice. The resulting higher junction temperature of the output transistor part is taken into account.

Device mounted on a ceramic substrate; area = 2,5 cm<sup>2</sup>, thickness = 0,7 mm.

## **CHARACTERISTICS**

T <sub>i</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$V_{BE} = 0$ ; $V_{CE} = V_{CER} max$	<sup>1</sup> CES	<	10 μΑ	٩
Emitter cut-off current				
$I_C = 0$ ; $V_{EB} = 4 V$	<sup>1</sup> EBO	<	10 μΑ	4
D.C. current gain*				
$I_C = 150 \text{ mA}; V_{CE} = 10 \text{ V}$	hFE	>	1000	
$I_C = 500 \text{ mA}; V_{CE} = 10 \text{ V}$	hFE	>	2000	
Collector-emitter saturation voltage				
$I_C = 500 \text{ mA}$ ; $I_B = 0.5 \text{ mA}$	$v_{CEsat}$	<	1,3 V	
$I_C = 500 \text{ mA}; I_B = 0.5 \text{ mA}; T_j = 150 ^{\circ}\text{C}$	V <sub>CEsat</sub>	<	1,3 V	
Base-emitter saturation voltage				
$I_C = 500 \text{ mA}$ ; $I_B = 0.5 \text{ mA}$	$v_{BEsat}$	<	1,9 V	
Switching times (see also Fig. 3 and Fig. 4)				
$I_C = 500 \text{ mA}; I_{Bon} = -I_{Boff} = 0.5 \text{ mA}$				
Turn-on time	t <sub>on</sub>	typ.	400 ns	
Turn-off time	toff	typ.	1500 ns	

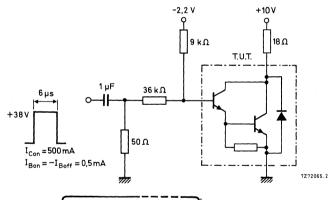
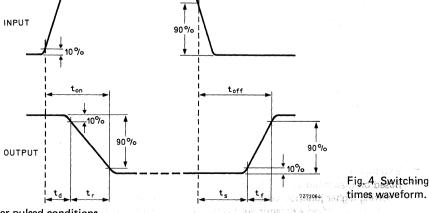


Fig. 3 Switching times test circuit.



<sup>\*</sup> Measured under pulsed conditions.

651

Fig. 4 Switching

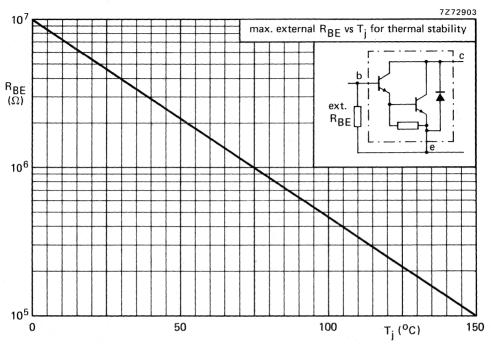


Fig. 5 Maximum values external  $R_{\mbox{\footnotesize{BE}}}$  as a function of junction temperature.

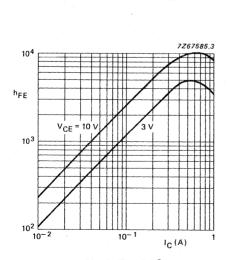


Fig. 6  $T_j = 25$  °C.

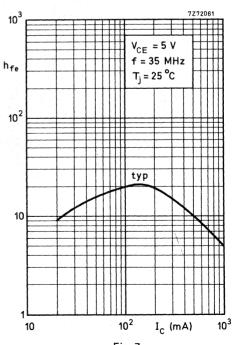


Fig. 7.

## P-N-P SILICON PLANAR DARLINGTON TRANSISTORS

Silicon p-n-p planar Darlington transistors for industrial switching applications, e.g. print hammer, solenoid, relay and lamp driving. Encapsulated in a microminiature plastic SOT-89 envelope.

N-P-N complements are BST50, BST51 and BST52 respectively.

## **QUICK REFERENCE DATA**

			BST60	BST61	BST62	2
Collector-base voltage (open emitter)	$-v_C$	BO max.	60	80	90	
Collector-emitter voltage	-V <sub>C</sub>	ER max.	45	60	80	٧
Collector current	−lc	max.	0,5	0,5	0,5	Α
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	- Control Control	1		W
D.C. current gain —I <sub>C</sub> = 500 mA; —V <sub>CE</sub> = 10 V	h <sub>FE</sub>	>		2000		
Collector-emitter saturation voltage $-I_C = 0,5 \text{ A}; -I_B = 0,5 \text{ mA}$	-V <sub>C</sub>	Esat <		1,3		V
Turn-off time $-I_C = 500 \text{ mA}; -I_{Bon} = I_{Boff} = 0.5$	mA t <sub>off</sub>	typ.		1500		n

Dimensions in mm

## **MECHANICAL DATA**

Fig. 1 SOT-89.

# 

BOTTOM VIEW

Mark

BST60 = BS1 BST61 = BS2

BST62 = BS3



See also Soldering recommendations.

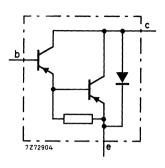


Fig. 2 Circuit diagram.

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BST60	BST61	BST62	?	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	60	80	90	V	
Collector-emitter voltage*	-V <sub>CER</sub>	max.	45	60	80	٧	
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5		٧	
Collector current (d.c.)	-IC	max.		0,5		Α	
Collector current (peak)	-ICM	max.		1,5		Α	
Base current (d.c.)	−I <sub>B</sub>	max.		0,1		Α	
Total power dissipation▲ up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.		1		W	
Storage temperature	$T_{stg}$		-	-65 to + 1	50	oC	
Junction temperature**	Τj	max.		150		oC	
THERMAL RESISTANCE**							
From junction to ambient▲	R <sub>th j-a</sub>	=		125		K/V	٧
From junction to tab	R <sub>th j-tab</sub>	=		10		K/V	V

<sup>\*</sup> External R<sub>BE</sub> not to exceed value shown in Fig. 5.

Based on maximum average junction temperature in line with common industrial practice. The resulting higher junction temperature of the output transistor part is taken into account.

<sup>▲</sup> Device mounted on a ceramic substrate area 2,5 cm², thickness = 0,7 mm.

## **CHARACTERISTICS**

T <sub>j</sub> = 25 °C unless otherwise specified			
Collector cut-off current			
$V_{BE} = 0$ ; $-V_{CE} = -V_{CER}$ max	<sup>−l</sup> ces	<	10 μΑ
Emitter cut-off current			
$I_C = 0$ ; $V_{EB} = 4 V$	−lEBO	<	10 μΑ
D.C. current gain*			
$-I_C = 150 \text{ mA}; -V_{CE} = 10 \text{ V}$	hFE	>	1000
$-I_C = 500 \text{ mA}; -V_{CE} = 10 \text{ V}$	hFE	>	2000
Collector-emitter saturation voltage			
$-I_C = 500 \text{ mA}; -I_B = 0.5 \text{ mA}$	−V <sub>CEsat</sub>	<	1,3 V
$-I_C = 500 \text{ mA}; -I_B = 0.5 \text{ mA}; T_j = 150 ^{\circ}\text{C}$	-V <sub>CEsat</sub>	<	1,3 V
Base-emitter saturation voltage			
$-I_C = 500 \text{ mA}; -I_B = 0.5 \text{ mA}$	-V <sub>BEsat</sub>	<	1,9 V
Switching times (see also Fig. 3 and Fig. 4)			
$-I_C = 500 \text{ mA}; -I_{Bon} = -I_{Boff} = 0.5 \text{ mA}$			
Turn-on time	ton	typ.	400 ns
Turn-off time	toff	typ.	1500 ns

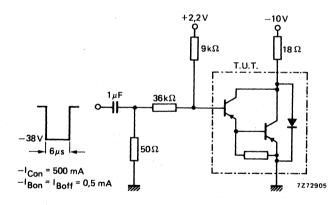


Fig. 3 Switching times test circuit.

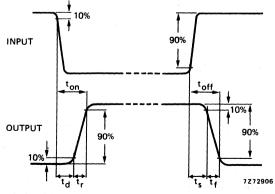


Fig. 4 Switching times waveform.

<sup>\*</sup> Measured under pulsed conditions.

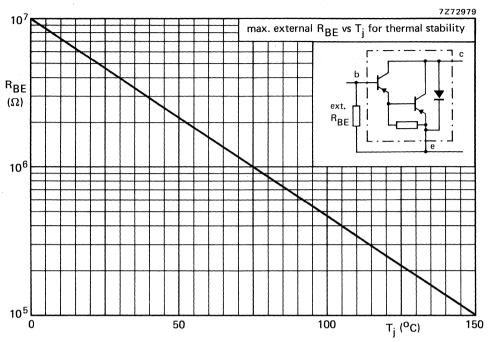
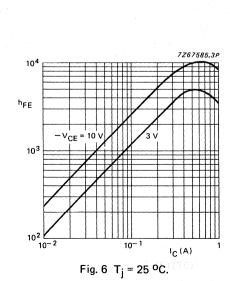
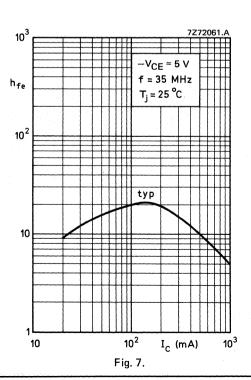


Fig. 5 Maximum values external  $R_{\mbox{\footnotesize{BE}}}$  as a function of junction temperature.





July 1984

## N-CHANNEL VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in SOT-89 envelope and designed for use as Surface Mounted Device (SMD) in thin and thick-film circuits for application with relay, high-speed and line-transformer drivers.

## **Features**

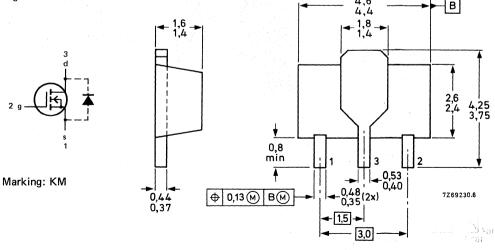
- Very low R<sub>DSon</sub>
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No second breakdown

#### QUICK REFERENCE DATA

Drain-source voltage	V <sub>DS</sub>	max.	80 V
Gate-source voltage (open drain)	$V_{GSO}$	max.	20 V
Drain current (d.c.)	I <sub>D</sub>	max.	0,5 A
Total power dissipation up to $T_{amb} = 25$ °C	P <sub>tot</sub>	max.	1 W
Drain-source ON-resistance $I_D = 500 \text{ mA}$ ; $V_{GS} = 10 \text{ V}$	R <sub>DSon</sub>	typ.	2,0 Ω 4,0 Ω
Transfer admittance $I_D = 500 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $f = 1 \text{ kHz}$	yfs	typ.	300 mS

## **MECHANICAL DATA**

Fig. 1 SOT-89.



January 1986

BOTTOM VIEW

RATINGS				
Limiting values in accordance with the Absolute Maximum System	(IEC 134)			
Drain-source voltage	VDS	max.	80	V
Gate-source voltage (open drain)	VGSO	max.	20	٧
Drain current (d.c.)	I <sub>D</sub>	max.	0,5	A
Drain current (peak)	IDM	max.	1,0	Α
Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	1	W
Storage temperature	T <sub>stg</sub>	-65 to ∃	150	оС
Junction temperature	Tj	max.	150	oC
THERMAL RESISTANCE				
From junction to ambient*	R <sub>th j-a</sub>		125	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Drain-source breakdown voltage $I_D = 100 \mu A; V_{GS} = 0$	V <sub>(BR)DS</sub>	>	80	V
Drain-source leakage current V <sub>DS</sub> = 60 V; V <sub>GS</sub> = 0	IDSS	<	10	μА
Gate-source leakage current VGS = 20 V; VDS = 0	IGSS	<	100	nA
Gate threshold voltage		>	1,5	٧
$I_D = 1 \text{ mA}; V_{DS} = V_{GS}$	V <sub>GS(th)</sub>	<	3,5	٧
Drain-source ON-resistance I <sub>D</sub> = 500 mA; V <sub>GS</sub> = 10 V	R <sub>DSon</sub>	typ.	2,0 4,0	
Transfer admittance at f = 1 kHz I <sub>D</sub> = 500 mA; V <sub>DS</sub> = 15 V	y <sub>fs</sub>	typ.	300	mS
Input capacitance at f = 1 MHz V <sub>DS</sub> = 10 V; V <sub>GS</sub> = 0	C <sub>is</sub>	typ.	45	pF
Output capacitance at f = 1 MHz V <sub>DS</sub> = 10 V; V <sub>GS</sub> = 0	Cos	typ.	30	рF
Feedback capacitance at f = 1 MHz V <sub>DS</sub> = 10 V; V <sub>GS</sub> = 0	C <sub>rs</sub>	typ.	8	pF
Switching times (see Figs 2 and 3) $I_D = 500 \text{ mA}$ ; $V_{DS} = 50 \text{ V}$ ; $V_{GS} = 0 \text{ to } 10 \text{ V}$	t <sub>on</sub> t <sub>off</sub>	< < <		ns ns

<sup>\*</sup> Transistors mounted on a substrate with surface area of 2,5 cm² and thickness of 0,7 mm.

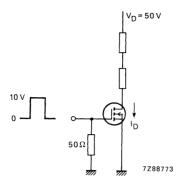


Fig. 2 Switching times test circuit.

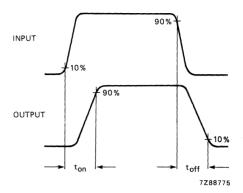


Fig. 3 Input and output waveforms.



## N-CHANNEL VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in SOT-23 envelope and designed for use as Surface Mounted Device (SMD) in thin and thick-film circuits for telephone ringer and for application with relay, high-speed and line transformer drivers.

#### **Features**

- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No second breakdown

## QUICK REFERENCE DATA

Drain-source voltage	V <sub>DS</sub>	max.	80 V
Drain-source voltage (non-repetitive peak; $t_p \le 2$ ms)	V <sub>DS(SM)</sub>	max.	100 V
Gate-source voltage (open drain)	$V_{GSO}$	max.	20 V
Drain current (d.c.)	۱ <sub>D</sub>	max.	175 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	300 mW
Drain-source ON-resistance $I_D = 150 \text{ mA}$ ; $V_{GS} = 5 \text{ V}$	R <sub>DSon</sub>	typ.	7 Ω 10 Ω
Transfer admittance $I_D = 175 \text{ mA}$ ; $V_{DS} = 5 \text{ V}$ ; $f = 1 \text{ kHz}$	y <sub>fs</sub>	typ.	150 mS

## **MECHANICAL DATA**

10° max

\_ 1,1 \_max

30°

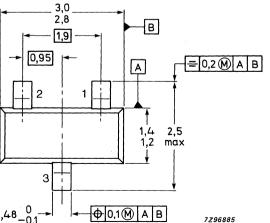
max

Fig. 1 SOT-23.

Marking: 02

0,1 max <u>₹</u> 10° ₹ max

0,150 0.090



TOP VIEW

April 1987

RATINGS				
Limiting values in accordance with the Absolute Maximum System (	IEC 134)			
Drain-source voltage	VDS	max.	80	V
Drain-source voltage (non-repetitive peak; $t_p \le 2$ ms)	V <sub>DS(SM)</sub>	max.	100	٧
Gate-source voltage (open drain)	$V_{GSO}$	max.	20	٧
Drain surrent (d.c.)	ID	max.	175	mΑ
Drain current (peak)	IDM	max.	600	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	300	mW
Storage temperature range	T <sub>stg</sub>	-65  to  +	150	οС
Junction temperature	Tj	max.	150	οС
THERMAL RESISTANCE				
From junction to ambient*	R <sub>th j-a</sub>	<b>=</b> - 1	430	K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Drain-source breakdown voltage				
$I_D = 100  \mu A;  V_{GS} = 0$	V <sub>(BR)DS</sub>	>	80	٧
Drain-source leakage current $V_{DS} = 60 \text{ V}$ ; $V_{GS} = 0$	IDSS	<	1,0	μΑ
Gate-source leakage current V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0	IGSS	<	100	nA
Gate-source cut-off voltage $I_D = 1 \text{ mA}$ ; $V_{DS} = V_{GS}$	V <sub>(P)GS</sub>	> <	1,5 3,5	
Drain-source ON-resistance I <sub>D</sub> = 150 mA; V <sub>GS</sub> = 5 V	R <sub>DSon</sub>	typ.	7 10	Ω
Transfer admittance at f = 1 kHz I <sub>D</sub> = 175 mA; V <sub>DS</sub> = 5 V	y <sub>fs</sub>	typ.	150	mS
Input capacitance at f = 1 MHz V <sub>DS</sub> = 10 V; V <sub>GS</sub> = 0	Cis	typ.	15	pF
Output capacitance at $f = 1 \text{ MHz}$ $V_{DS} = 10 \text{ V}$ ; $V_{GS} = 0$	Cos	typ.	13	pF
Feedback capacitance at $f = 1 \text{ MHz}$ $V_{DS} = 10 \text{ V}; V_{GS} = 0$	C <sub>rs</sub>	typ.	3	pF
Switching times (see Figs 2 and 3) $I_D = 175 \text{ mA}$ ; $V_{DS} = 50 \text{ V}$ ; $V_{GS} = 0 \text{ to } 10 \text{ V}$	t <sub>on</sub>	typ.		ns ns
· · · · · · · · · · · · · · · · · · ·				

typ.

toff

<sup>\*</sup> Transistors mounted on a ceramic substrate of 7 mm  $\times$  5 mm  $\times$  0,7 mm.

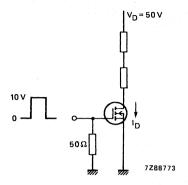


Fig. 2 Switching times test circuit.

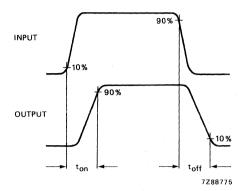


Fig. 3 Input and output waveforms.

## N-CHANNEL VERTICAL D-MOS TRANSISTOR

N-channel vertical D-MOS transistor in SOT-89 envelope and designed for use as line current interrupter in telephone sets and for application in relay, high-speed and line-transformer drivers.

#### **Features**

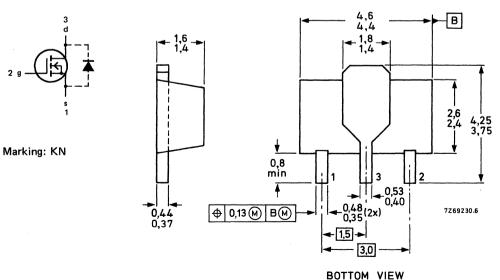
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No second breakdown

#### **QUICK REFERENCE DATA**

Drain-source voltage	$v_{DS}$	max.	200 V
Gate-source voltage (open drain)	$v_{GSO}$	max.	20 V
Drain current (d.c.)	I <sub>D</sub>	max.	250 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	1 W
Drain-source ON-resistance I <sub>D</sub> = 250 mA; V <sub>GS</sub> = 10 V	R <sub>DSon</sub>	typ.	6 Ω 12 Ω
Transfer admittance $I_D = 250 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $f = 1 \text{ kHz}$	y <sub>fs</sub>	typ.	250 mS

## **MECHANICAL DATA**

Fig. 1 SOT-89.



Limiting values in accordance with the Absolute Maximum System (IEC 134)							
Drain-source voltage		$v_{DS}$	max.				
Gate-source voltage (open drain)		$V_{GSO}$	max.				
Drain current (d.c.)		ID	max.				
Drain current (peak)		IDM	max.				
Total power dissipation up to T <sub>amb</sub> = 25 °C*		P <sub>tot</sub>	max.				

200 V

20 V 250 mA 800 mA 1 W

-65 to + 150 °C

T<sub>stq</sub>

Storage temperature

Junction temperature	T <sub>j</sub>	max.	150 °C
THERMAL RESISTANCE			
From junction to ambient	R <sub>th j-a</sub>	= 1	125 K/W
CHARACTERISTICS			
T <sub>j</sub> = 25 °C unless otherwise specified			
Drain-source breakdown voltage $I_D = 100 \mu A$ ; $V_{GS} = 0$	V <sub>(BR)DS</sub>	>	200 V
Drain-source leakage current $V_{DS} = 160 \text{ V}$ ; $V_{GS} = 0$	IDSS	<	10 μΑ
Gate-source leakage current $V_{GS} = 20 \text{ V}; V_{DS} = 0$	I <sub>GSS</sub>	<	100 nA
Gate threshold voltage $I_D = 1 \text{ mA}$ ; $V_{DS} = V_{GS}$	V <sub>GS(th)</sub>	> 1 2 2 2	0,8 V 2,8 V
Drain-source ON-resistance $I_D = 250 \text{ mA}$ ; $V_{GS} = 10 \text{ V}$	R <sub>DSon</sub>	typ.	6 Ω 12 Ω
Transfer admittance at $f = 1 \text{ kHz}$ $I_D = 250 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$	y <sub>fs</sub>	typ.	250 mS
Input capacitance at $f = 1 \text{ MHz}$ $V_{DS} = 10 \text{ V}; V_{GS} = 0$	C <sub>is</sub>	typ.	70 pF
Output capacitance at f = 1 MHz V <sub>DS</sub> = 10 V; V <sub>GS</sub> = 0	Cos	typ.	20 pF
Feedback capacitance at $f = 1 \text{ MHz}$ $V_{DS} = 10 \text{ V}$ ; $V_{GS} = 0$	C <sub>rs</sub>	typ.	5 pF
Switching times (see Figs 2 and 3) $I_D = 250 \text{ mA}$ ; $V_{DS} = 50 \text{ V}$ ; $V_{GS} = 0 \text{ to } 10 \text{ V}$	t <sub>on</sub>	typ.	4 ns 10 ns
	toff	typ.	15 ns 25 ns

<sup>\*</sup> Transistor mounted on a ceramic substrate with area of 2,5 cm² and thickness of 0,7 mm.

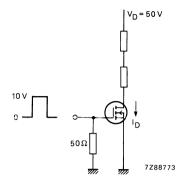


Fig. 2 Switching times test circuit.

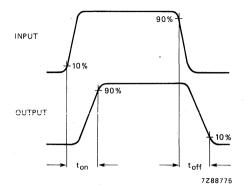


Fig. 3 Input and output waveforms.

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## N-CHANNEL VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in SOT-89 envelope and designed for use as Surface Mounted Device (SMD) in thin and thick-film circuits for application with relay, high-speed and line-transformer drivers.

## **Features**

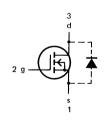
- Direct interface to C-MOS, TTL, etc.
- High-speed switching
- No second breakdown

## **QUICK REFERENCE DATA**

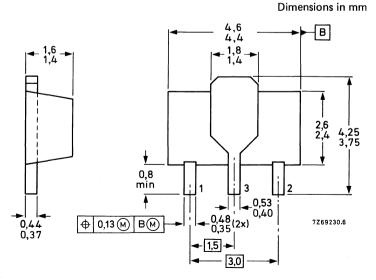
Drain-source voltage	$V_{DS}$	max.	180 V
Drain-source voltage (non-repetitive peak; $t_p \le 2$ ms)	V <sub>DS(SM)</sub>	max.	200 V
Gate-source voltage (open drain)	$V_{GSO}$	max.	20 V
Drain current (d.c.)	l <sub>D</sub>	max.	300 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	1 W
Drain-source ON-resistance $I_D = 15 \text{ mA}$ ; $V_{GS} = 3 \text{ V}$	R <sub>DSon</sub>	typ.	7 Ω 10 Ω
Transfer admittance $I_D = 300 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$ ; $f = 1 \text{ kHz}$	y <sub>fs</sub>	typ.	250 mS

## **MECHANICAL DATA**

Fig. 1 SOT-89.



Marking: K0



BOTTOM VIEW

RATINGS					
Limiting values in accordance with the Absolute Maximum System	Limiting values in accordance with the Absolute Maximum System (IEC 134)				
Drain-source voltage	$V_{DS}$	max.	180	V	
Drain-source voltage (non-repetitive peak; $t_p \le 2$ ms)	V <sub>DS(SM)</sub>	max.	200	V	
Gate-source voltage (open drain)	$v_{GSO}$	max.	20	٧	
Drain current (d.c.)	ID	max.	300	mΑ	
Drain current (peak)	IDM	max.	800	mΑ	
Total power dissipation up to T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	1	W	
Storage temperature	$T_{stg}$	-65 to +	150	οС	
Junction temperature	Тj	max.	150	оС	
THERMAL RESISTANCE					
From junction to ambient*	R <sub>th j-a</sub>	= ,	125	K/W	
CHARACTERISTICS					
T <sub>j</sub> = 25 °C unless otherwise specified					
Drain-source breakdown voltage $I_D = 100 \mu A; V_{GS} = 0$	V <sub>(BR)DS</sub>	>	180	V	
Drain-source leakage current V <sub>DS</sub> = 120 V; V <sub>GS</sub> = 0	IDSS	<	10	μΑ	
Gate-source leakage current V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0	IGSS	<	100	nA	
Gate threshold voltage		>	0,7	V	
$I_D = 100 \mu\text{A}; V_{DS} = V_{GS}$	V <sub>GS(th)</sub>	<	2,7		
Drain-source ON-resistance	D	typ.	7	Ω	
$I_D = 15 \text{ mA}; V_{GS} = 3 \text{ V}$	R <sub>DSon</sub>	<	10	_	
$I_D = 300 \text{ mA}$ ; $V_{GS} = 10 \text{ V}$	$R_{DSon}$	typ.	6	Ω	
Transfer admittance at $f = 1 \text{ kHz}$ $I_D = 300 \text{ mA}$ ; $V_{DS} = 15 \text{ V}$	yfs	typ.	250	mS	
Input capacitance at $f = 1 \text{ MHz}$ $V_{DS} = 10 \text{ V}; V_{GS} = 0$	Cis	typ.	50	pF	
Output capacitance at $f = 1 \text{ MHz}$ $V_{DS} = 10 \text{ V}; V_{GS} = 0$	Cos	typ.	20	pF	
Feedback capacitance at $f = 1 \text{ MHz}$ $V_{DS} = 10 \text{ V}; V_{GS} = 0$	C <sub>rs</sub>	typ.	6	pF	
Switching times (see Figs 2 and 3)					
$I_D = 300 \text{ mA}; V_{DS} = 50 \text{ V}; V_{GS} = 0 \text{ to } 10 \text{ V}$	<sup>t</sup> on <sup>t</sup> off	<		ns ns	

<sup>\*</sup> Transistors mounted on a ceramic substrate with area of 2,5 cm² and thickness of 0,7 mm.

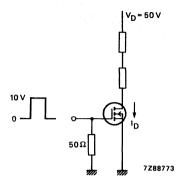


Fig. 2 Switching times test circuit.

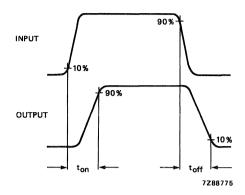


Fig. 3 Input and output waveforms.



## **DEVELOPMENT DATA**

This data sheet contains advance information and specifications are subject to change without notice.

## P-CHANNEL VERTICAL D-MOS TRANSISTOR

P-channel vertical D-MOS transistor in SOT-89 envelope and intended for use in relay, high-speed and line-transformer drivers, using SMD technology.

## **Features**

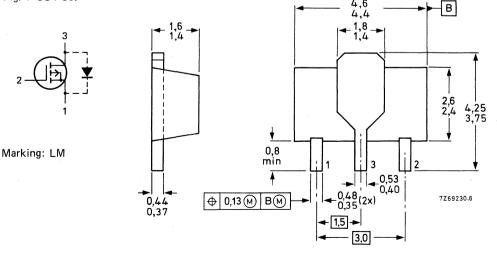
- Very low R<sub>DSon</sub>
- Direct interface to C-MOS
- High-speed switching
- No second breakdown

## QUICK REFERENCE DATA

Drain-source voltage	-V <sub>DS</sub>	max.	60 V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	20 V
Drain current (d.c.)	$-I_D$	max.	0,3 A
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	1 W
Drain-source ON-resistance $-I_D = 200 \text{ mA}; -V_{GS} = 10 \text{ V}$	R <sub>DSon</sub>	typ. max.	4,5 Ω 6 Ω
Transfer admittance $-I_D = 200 \text{ mA}$ ; $-V_{DS} = 15 \text{ V}$ ; $f = 1 \text{ kHz}$	yfs	typ.	200 mS

## **MECHANICAL DATA**

Fig. 1 SOT-89.



BOTTOM VIEW

n (IEC 134)			
$-v_{DS}$	max.	60	٧ ,
$-v_{GSO}$	max.	20	V -
$-I_{D}$	max.	0,3	Α
$-I_{DM}$	max.	0,8	Α
$P_{tot}$	max.	1	W
$T_{stg}$	-65 to +	150	oC
Tj	max.	150	oC
R <sub>th j-a</sub>	=	125	K/W
-V <sub>(BR)DS</sub>	>	60	٧
−I <sub>DSS</sub>	<	10	μΑ
-I <sub>GSS</sub>	<	100	nA
	>	15	V
-V <sub>GS(th)</sub>	<	3,5	
R <sub>DSon</sub>	typ.	4,5 6	$\Omega$
y <sub>fs</sub>	typ.	200	mS
C <sub>is</sub>	typ.	55	рF
Cos	typ.	30	pF
C <sub>rs</sub>	typ.	8	pF
	-VDS -VGSO -ID -IDM Ptot Tstg Tj  Rth j-a  -V(BR)DS -IDSS -IGSS -VGS(th)  RDSon  IYfs  Cis Cos	-VDS maxVGSO maxID maxID maxIDM max.  Ptot max. Tstg -65 to + Tj max.  Rth j-a =  -V(BR)DS > -IDSS < -IGSS < -VGS(th) < RDSon typ. Cis typ. Cos typ.	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$

<sup>\*</sup> Transistor mounted on a ceramic substrate: area = 2,5 cm² and thickness = 0,7 mm.

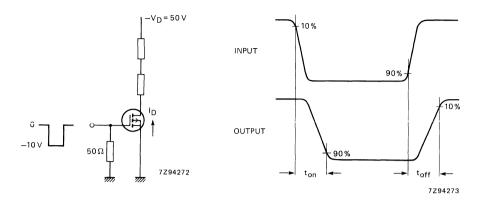


Fig. 2 Switching time test circuit.

Fig. 3 Input and output waveforms.

schra.

This data sheet contains advance information and specifications are subject to change without notice.

## P-CHANNEL VERTICAL D-MOS TRANSISTOR

P-channel vertical D-MOS transistor in SOT-89 envelope and intended for use in relay, high-speed and line-transformer drivers, using SMD-technology.

#### **Features**

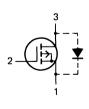
- Very low R<sub>DSon</sub>
- Direct interface to C-MOS, TTL
- High-speed switching
- No second breakdown

## **QUICK REFERENCE DATA**

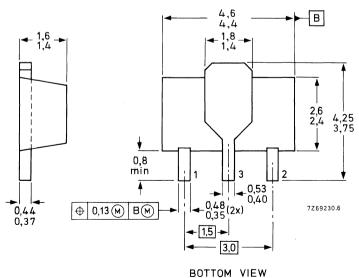
Drain-source voltage	$-V_{DS}$	max.	50 V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	20 V
Drain current (d.c.)	-ID	max.	0,25 A
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	1 W
Drain-source ON-resistance $-I_D = 200 \text{ mA}; -V_{GS} = 10 \text{ V}$	R <sub>DSon</sub>	typ.	7,5 Ω 10 Ω
Transfer admittance $-I_D = 200 \text{ mA}; -V_{DS} = 15 \text{ V}; f = 1 \text{ kHz}$	y <sub>fs</sub>	typ.	125 mS

## **MECHANICAL DATA**

Fig. 1 SOT-89.



Marking: LN



DOTTON VIEW

	RATINGS				
	Limiting values in accordance with the Absolute Maximum System	(IEC 134)			
	Drain-source voltage	$-V_{DS}$	max.	50	٧
	Gate-source voltage (open drain)	$-V_{GSO}$	max.	20	٧
	Drain current (d.c.)	$-I_D$	max.	0,25	Α
	Drain current (peak)	-IDM	max.	0,5	Α
	Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	1	W
	Storage temperature	$T_{stg}$	-65 to	+ 150	oC
	Junction temperature	Tj	max.	150	oC
	THERMAL RESISTANCE				
	From junction to ambient*	R <sub>th j-a</sub>	=	125	K/W
	CHARACTERISTICS				
	T <sub>j</sub> = 25 <sup>o</sup> C unless otherwise specified				
	Drain-source breakdown voltage $-I_D = 100 \mu A; -V_{GS} = 0$	-V <sub>(BR)DS</sub>	>	50	٧
	Drain-source leakage current $-V_{DS} = 1 V; V_{GS} = 0$	-I <sub>DSS</sub>	<	10	μΑ
	Gate-source leakage current -V <sub>GS</sub> = 20 V; V <sub>DS</sub> = 0	-I <sub>GSS</sub>	<	100	nA
	Gate threshold voltage $-I_D = 1 \text{ mA}$ ; $V_{DS} = V_{GS}$	-V <sub>GS(th)</sub>	> <	1,5 3,5	
	Drain-source ON-resistance $-I_D = 200 \text{ mA}; -V_{GS} = 10 \text{ V}$	R <sub>DSon</sub>	typ.	7,5 10	
	Transfer admittance at $f = 1 \text{ kHz}$ - $I_D = 200 \text{ mA}$ ; - $V_{DS} = 15 \text{ V}$	y <sub>fs</sub>	typ.	125	mS
•	Input capacitance at $f = 1 \text{ MHz}$ $-V_{DS} = 10 \text{ V}; V_{GS} = 0$	C <sub>is</sub>	typ.	30	pF
-	Output capacitance at $f = 1 \text{ MHz}$ - $V_{DS} = 10 \text{ V}$ ; $V_{GS} = 0$	Cos	typ.	20	pF
-	Feedback capacitance at $f = 1 \text{ MHz}$ $-V_{DS} = 10 \text{ V}; V_{GS} = 0$	C <sub>rs</sub>	typ.	5	pF
>	Switching times (see Figs 2 and 3) $-I_D = 200 \text{ mA}; -V_{DS} = 40 \text{ V}; -V_{GS} = 0 \text{ to } 10 \text{ V}$	<sup>t</sup> on <sup>t</sup> off	typ.	4 10	ns ns
		TIU	- 1 P.		

<sup>\*</sup> Transistor mounted on a ceramic substrate: area = 2,5 cm²; thickness = 0,7 mm.

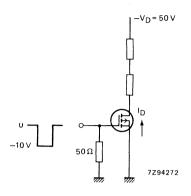


Fig. 2 Switching times test circuit.

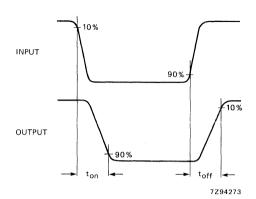


Fig. 3 Input and output waveforms.

## SILICON PLANAR EPITAXIAL TRANSISTORS

## High-speed switching

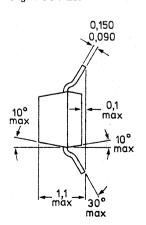
N-P-N transistor in a microminiature plastic envelope. It is intended for very high-speed saturated switching in thick and thin-film circuits.

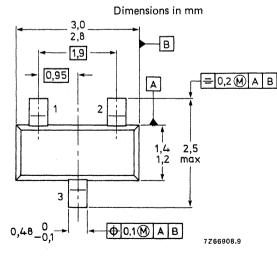
## **QUICK REFERENCE DATA**

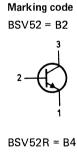
Collector-base voltage (open emitter)	$v_{CBO}$	max.	20 V
Collector-emitter voltage (V <sub>BE</sub> = 0)	$v_{CES}$	max.	20 V
Collector-emitter voltage (open base)	VCEO	max.	12 V
Collector current (peak value)	ICM	max.	200 mA
Total power dissipation up to T <sub>amb</sub> = 65 °C	$P_{tot}$	max.	250 mW
Junction temperature	Ti	max.	175 °C
D.C. current gain $I_C = 10 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$ $I_C = 50 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE hFE	40 t	o 120 25
Transition frequency at $f = 100 \text{ MHz}$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	f <sub>T</sub>	> typ.	400 MHz 500 MHz
Storage time $I_C = I_B = -I_{BM} = 10 \text{ mA}$	t <sub>s</sub>	<	13 ns

## **MECHANICAL DATA**

Fig. 1 SOT-23.







1—

R-types are available on request.

See also Soldering recommendations.

RATINGS				
Limiting values in accordance with the Absolute Maximum Syste	m (IEC 134)			
Collector-base voltage (open emitter) See Fig. 4	V <sub>CBO</sub>	max.	20	V
Collector-emitter voltage (V <sub>BE</sub> = 0) See Fig. 4	V <sub>CES</sub>	max.	20	V
Collector-emitter voltage (open base)				
$I_C = 10 \text{ mA}$ (see Fig. 4)	VCEO	max.	12	V
Emitter-base voltage (open collector) See Fig. 4	$V_{EBO}$	max.	5	V
Collector current (d.c.)	IC	max.	100	mΑ
Collector current (peak value)	I <sub>CM</sub>	max.	200	mΑ
Total power dissipation up to $T_{amb} = 65  {}^{\circ}\text{C}$ **	$P_{tot}$	max.	250	mW
Storage temperature	$T_{stg}$	-65 to +	175	oC
Junction temperature	Tj	max.	175	оС
THERMAL CHARACTERISTICS*				
$T_j = Px (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
From junction to tab	R <sub>th j-t</sub>	= '	60	K/W
From tab to soldering points	R <sub>th t-s</sub>	=	280	K/W
From soldering points to ambient**	R <sub>th s-a</sub>	=		K/W
CHARACTERISTICS				
T <sub>i</sub> = 25 °C unless otherwise specified				
Collector cut-off current				
$I_E = 0$ ; $V_{CB} = 10 \text{ V}$	СВО	<	100	
$I_E = 0$ ; $V_{CB} = 10 \text{ V}$ ; $T_j = 125 ^{\circ}\text{C}$	ІСВО	<	5	μΑ
Saturation voltages $I_C = 10 \text{ mA}$ ; $I_B = 300 \mu A$	V	<	300	m\/
10 - 10 π.Α., 18 - 300 μ.Α	V <sub>CEsat</sub>	· \		
$I_C = 10 \text{ mA}; I_B = 1 \text{ mA}$	V <sub>CEsat</sub>		250	
	V <sub>BEsat</sub>	700 to		
$I_C = 50 \text{ mA}; I_B = 5 \text{ mA}$	V <sub>CEsat</sub>	<	400	
	<b>VBEsat</b>	<	1200	mv
D.C. current gain I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 1 V	hee	>	25	
IC = 10 mA; VCE = 1 V	hFE hFE	40 to		
$I_C = 50 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	>	25	
Transition frequency at f = 100 MHz		>	400	MHz
$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$	fΤ	typ.		MHz
		-,		

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

Collector capacitance at f = 1 MHz  $I_E = I_e = 0; V_{CB} = 5 \text{ V}$  $C_{\mathbf{c}}$ 4 pF Emitter capacitance at f = 1 MHz  $I_C = I_c = 0; V_{FB} = 1 V$ 4,5 pF  $C_{e}$ Switching times Storage time  $I_C = I_B = -I_{BM} = 10 \text{ mA}$ 13 ns Turn on time when switched from  $-V_{BE} = 1.5 \text{ V to I}_{C} = 10 \text{ mA}; I_{B} = 3 \text{ mA}$ 12 ns ton Turn off time when switched from  $I_C = 10 \text{ mA}; I_B = 3 \text{ mA}$ to cut-off with  $-I_{BM} = 1.5 \text{ mA}$ toff 18 ns

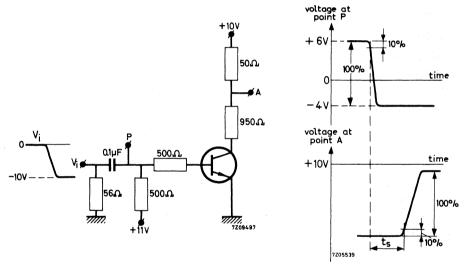


Fig. 2 Test circuit and waveform storage time.

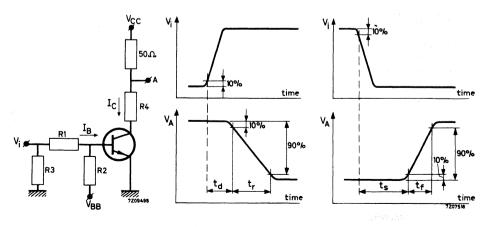


Fig. 3 Test circuit and waveforms turn on and turn off time.

Pulse generator:

Oscilloscope:

Rise time

Rise time

- < 1 ns

Input impedance

 $R_i = 50 \Omega$ 

1 ns

Pulse duration Duty cycle > 300 ns 6 < 0,02

Source impedance

 $R_S = 50 \Omega$ 

								turn on time turn off time				f time
	I <sub>C</sub>	I <sub>B</sub>	−l <sub>BM</sub> mA	V <sub>CC</sub>	R <sub>1</sub> ; R <sub>2</sub> kΩ	R <sub>3</sub> Ω	R <sub>4</sub> Ω	−V <sub>BB</sub> V	−V <sub>BE</sub> V	V <sub>i</sub> V	V <sub>BB</sub> V	−V <sub>i</sub> ∨
	10	3	1,5	3	3,3	50	220	3,0	1,5	15	12,0	15

 $-I_{\mbox{BM}}$  is the reverse current that can flow during switching off. The indicated  $-I_{\mbox{BM}}$  is determined and limited by the applied cut-off voltage and series resistance.

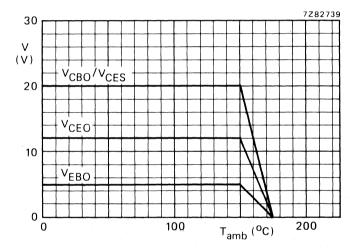


Fig. 4 Voltage derating curves.

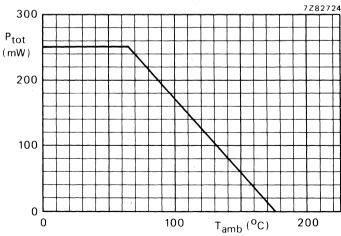


Fig. 5 Power derating curve.

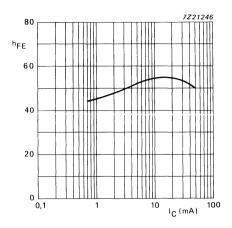


Fig. 6.  $V_{CE} = 1 \text{ V}$ ;  $T_j = 25 \, {}^{o}\text{C}$ ; typical values.

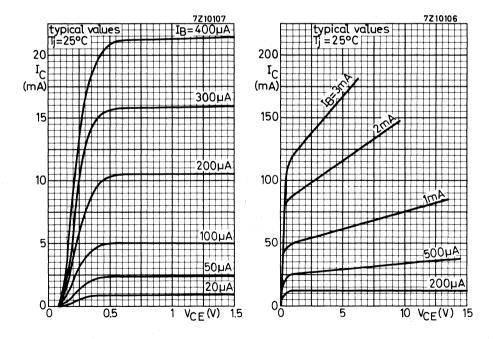


Fig. 7.

Fig. 8.

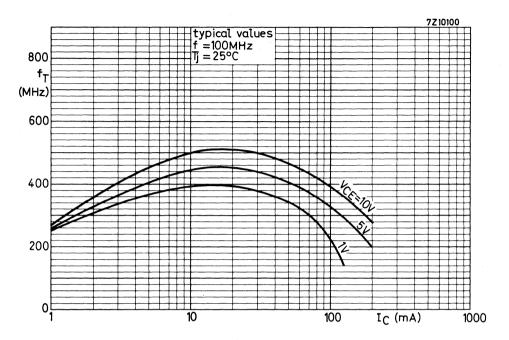


Fig. 9.

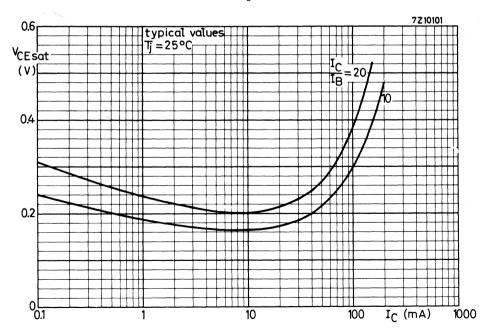


Fig. 10.

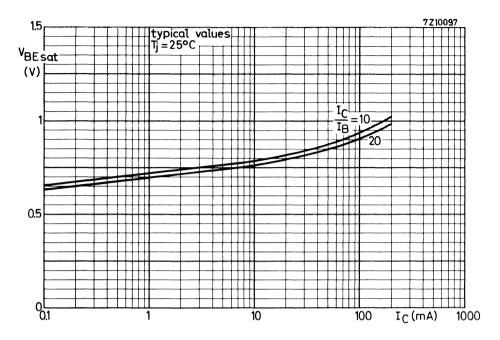
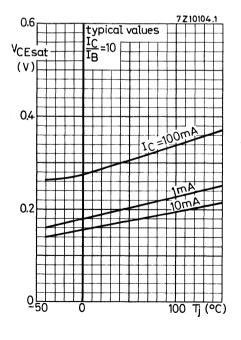


Fig. 11.



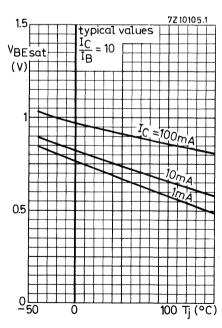
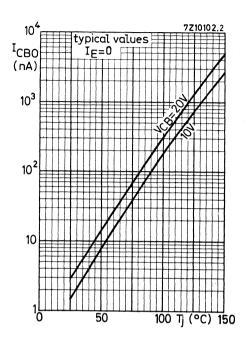


Fig. 12.

Fig. 13.



6 C<sub>c</sub> | f = 1MHz | 7210103 | f = 1MHz | 7510103 |

Fig. 14.

Fig. 15.

This data sheet contains advance information and specifications are subject to change without notice.

# CONTROLLED AVALANCHE RECTIFIER DIODES

Rectifier diodes in hermetically sealed leadless  $SMID^*$  envelopes and intended for general purpose rectifier applications.

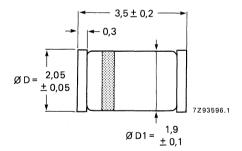
The device is capable of absorbing reverse transient energy.

### QUICK REFERENCE DATA

			BYD17D	G	J	K	M	
Crest working voltage	$V_{RWM}$	max.	200	400	600	800	1000	V
Reverse avalanche breakdown voltage	V <sub>(BR)R</sub>	> <	225 1600	450 1600	650 1600	900 1600	1100 1600	-
Average forward current	IF(AV)	max.			1,5			Α
Non-repetitive peak forward current	<sup>I</sup> FSM	max.			20			Α
Non-repetitive peak reverse power dissipation	P <sub>RSM</sub>	max.			0,4			kW
Junction temperature	Tj	max.			175			oC

### **MECHANICAL DATA**

Fig. 1 SOD-87.



Dimensions in mm

<sup>\*</sup> Surface-mounted implosion diode.

# **BYD17 SERIES**

### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BYD17D	G	J	K	M	
Crest working reverse voltage	$v_{RWM}$	max.	200	400	600	800	1000	٧
Continuous reverse voltage	$v_R$	max.	200	400	600	800	1000	V
Average forward current (averaged over any 20 ms period)  Ttp = 105 °C; lead length 10 mm	ļF(AV)	max.			1,5			A
$T_{amb} = 65$ °C; p.c. board mounting	<sup>I</sup> F(AV)	max.			0,6			Α
Repetitive peak forward current  T <sub>tp</sub> = 55 °C; f = 50 Hz; a = 3; (inclusive derating for T <sub>j max</sub> at V <sub>RRM</sub> = 1000 V)	I <sub>FRM</sub>	max.			5,5			А
Non-repetitive peak forward current t = 10 ms, half-sine wave; T <sub>j</sub> = T <sub>j max</sub> prior to surge;								
V <sub>R</sub> = V <sub>RWMmax</sub>	<sup>I</sup> FSM	max.			20			Α
Non-repetitive peak reverse power dissipation; $t = 20 \mu s$ (half-sine								
wave); $T_j = T_{j \text{ max}}$ prior to surge	PRSM	max.			0,4			kW .
Non-repetitive peak reverse avalanche energy; $I_R = 0.34 \text{ A}$ ; $T_j = T_{j \text{ max}}$ prior to surge; with inductive load	-				_			
switched off	E <sub>RSM</sub>	max.			7			mJ
Storage temperature	T <sub>stg</sub>		_	65 to -				°C
Junction temperature	Тj	max.			175			оС
THERMAL RESISTANCE								
Influence of mounting method								
Thermal resistance from junction to tie-point at a lead length of 10 mm	R <sub>th j-tp</sub>	=			30			K/W
<ol><li>Thermal resistance from junction to ambient; device mounted on an 1,5 mm thick epoxy-glass printed circuit board;</li></ol>								
Cu-thickness $\geq$ 40 $\mu$ m (see Fig. 2)	R <sub>th j-a</sub>	=			150			K/W

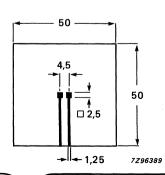


Fig. 2 Mounted on a printed-circuit board.

### **CHARACTERISTICS**

T<sub>i</sub> = 25 °C unless otherwise specified

			BYD17D	G	J	K	M	
Forward voltage*								
I <sub>F</sub> = 1 A; T <sub>i</sub> = T <sub>i max</sub>	٧F	<	0,93	0,93	0,93	0,93	0,93	V
I <sub>F</sub> = 1 A	٧F	<	1,05	1,05	1,05	1,05	1,05	V
Reverse avalanche breakdown voltage I <sub>R</sub> = 0,1 mA	V <sub>(BR)R</sub>	>	225 1600	450 1600	650 1600	900 1600	1100 1600	-
Reverse current			1000	1000	1000	1000	1000	V
					_			
$V_R = V_{RWMmax}$	<sup>I</sup> R	<			1			μΑ
V <sub>R</sub> = V <sub>RWMmax</sub> ; T <sub>j</sub> = 165 °C	۱ <sub>R</sub>	<			100			μΑ
Diode capacitance								
$V_R = 0$ ; $f = 1 MHz$	Cd	typ	•		21			pF

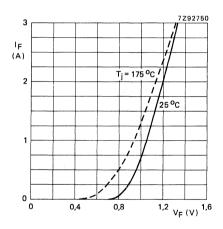


Fig. 3 Maximum forward voltage.

<sup>\*</sup> Measured under pulse conditions to avoid excessive dissipation.

BYD37D;G;J;K;M

# AVALANCHE FAST SOFT-RECOVERY RECTIFIER DIODES

Rectifier diodes in hermetically sealed leadless SMID\* envelopes. They are intended for television and industrial applications, such as switched-mode power supplies, scan rectifiers in TV receivers and also for use in inverter and converter applications. The devices feature non-snap-off (soft-recovery) switching characteristics and are capable of absorbing reverse transient energy (e.g. during flashover in a picture tube).

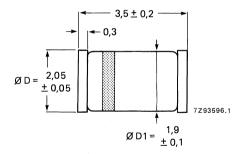
#### QUICK REFERENCE DATA

			BYD37D	G	J	K	M	
Repetitive peak reverse voltage	$v_{RRM}$	max.	200	400	600	800	1000	V
Continuous reverse voltage	$v_R$	max.	200	400	600	600	1000	V
Average forward current	IF(AV)	max.		1,5		•	1,5	Α
Non-repetitive peak forward current	IFSM	max.		20			20	Α
Non-repetitive peak reverse energy	ERSM	max.		10			7	mJ
Reverse recovery time	t <sub>rr</sub>	<		250		3	00	ns

#### **MECHANICAL DATA**

Fig. 1 SOD-87.

Dimensions in mm



<sup>\*</sup> Surface mounted implosion diode.

## **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			BYD37D	G	J	K	M	
Repetitive peak reverse voltage	$V_{RRM}$	max.	200	400	600	800	1000	V
Continuous reverse voltage	VR	max.	200	400	600	800	1000	٧
Average forward current (averaged over any 20 ms period)				<del></del>			·	
$T_{tp} = 105  {}^{\circ}\text{C}$ $T_{amb} = 65  {}^{\circ}\text{C}$ ; p.c. board mounting	IF(AV) IF(AV)	max. max.		1,5 0,6			,5 ,6	A A
Repetitive peak forward current	IFRM	max.		12		•	12	Α
Non-repetitive peak forward current t = 10 ms, half-sine wave; T <sub>j</sub> = T <sub>j max</sub> prior to surge; V <sub>R</sub> = V <sub>R</sub> RMmax	<sup>I</sup> FSM	max.		20			20	Α
Non-repetitive peak reverse avalanche energy; $I_R = 400 \text{ mA}$ ; $T_j = T_j \text{ max}$ , prior to surge; with inductive load						•		
switched off	ERSM	max.		10	05	. 475	7	mJ
Storage temperature	T <sub>stg</sub>				-65 to	+1/5		oC
Junction temperature	Tj	max.			175			oC
THERMAL RESISTANCE					•			
Influence of mounting method  1. Thermal resistance from junction								
to tie-point	R <sub>th j-tp</sub>	=			30			K/W
2. Thermal resistance from junction to ambient; device mounted on a 1,5 mm thick epoxy-glass printed circuit board; Cu-thickness ≥ 40 μm								
(see Fig. 2)	R <sub>th j-a</sub>	· , = _ , _ ,			150			K/W

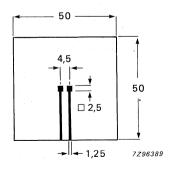


Fig. 2 Mounted on a printed-circuit board.

## **CHARACTERISTICS**

T<sub>i</sub> = 25 °C unless otherwise specified

			BYD37D	G	J	K	M	
Forward voltage*								•
I <sub>F</sub> = 1 A; T <sub>j</sub> = T <sub>j max</sub>	٧F	<	1,1	1,1	1,1	1,1	1,1	٧
IF = 1 A	٧F	<	1,3	1,3	,1,3	1,3	1,3	٧
Reverse avalanche breakdown voltage						İ		
$I_R = 0.1 \text{ mA}$	V(BR)R	>	300	500	700	900	1100	V
Reverse current								•
$V_R = V_{RRMmax}$	1R	<		1			1	μΑ
$V_R = V_{RRMmax}$ ; $T_j = 165$ °C	<sup>I</sup> R	<		100		1	00	μΑ
Reverse recovery when switched from								
$I_F = 1 \text{ A to } V_R \geqslant 30 \text{ V with}$								
$-dI_F/dt = 20 A/\mu s$	0			050		4	00	
recovery charge	$\alpha_{\rm s}$	>		250			00	nC
recovery time	t <sub>rr</sub>	<		250		3	00	ns
Maximum slope of reverse recovery current when switched from IF = 1 A to VB ≥ 30 V with								
$-dI_F/dt = 1 A/\mu s$	dl <sub>R</sub> /dt	<		6			5	A/μs

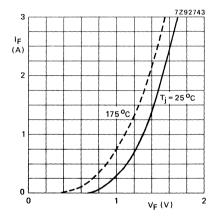


Fig. 3 Maximum forward voltage.

<sup>\*</sup> Measured under pulse conditions to avoid excessive dissipation.



This data sheet contains advance information and specifications are subject to change without notice.

# **VOLTAGE REGULATOR DIODES**

Diodes in hermetically sealed leadless SMID\* envelopes.

They are intended for use as voltage regulator in medium power regulator circuits.

The series consists of BZD27-C3V9 to BZD27-C270; diodes in the voltage range 300 V to 510 V are available on request.

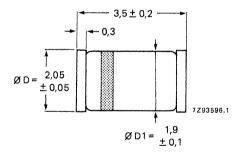
### QUICK REFERENCE DATA

Working voltage range	Vz	nom.	3,9 to 270 V
Working voltage tolerance (E24 range)			± 5 %
Total power dissipation	P <sub>tot</sub>	max.	2,3 W
Non-repetitive peak reverse power dissipation $T_j = 25$ °C; $t_p = 100 \mu s$	PZSM	max.	300 W

### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOD-87.



<sup>\*</sup> Surface mounted implosion diode.

### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Total power dissipation			
$T_{tp} = 105 \text{ oC}$	$P_{tot}$	max.	2,3 W
T <sub>amb</sub> = 55 °C; p.c. board mounting	$P_{tot}$	max.	0,8 W
Non-repetitive peak reverse power dissipation			
$t_p = 100 \mu s$ square pulse; $T_j = 25  ^{\circ}C$ (prior to surge)	PZSM	max.	300 W
Storage temperature	$T_{stg}$	65 t	o +175 °C
Junction temperature	$T_{j}$	max.	175 °C

### THERMAL RESISTANCE

Influence of mounting method

1. Thermal resistance from junction to tie-point	R <sub>th j-tp</sub>	=	30 K/W
--	----------------------	---	--------

2. Thermal resistance from junction to ambient when mounted on a 1,5 mm thick epoxy-glass printed-circuit board; Cu-thickness  $\geqslant$  40  $\mu$ m (see Fig. 2)

 $R_{th j-a} = 150 \text{ K/W}$ 

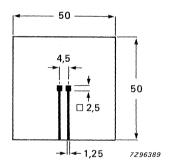


Fig. 2 Mounted on a printed-circuit board.

### **CHARACTERISTICS**

T<sub>i</sub> = 25 °C unless otherwise specified

Forward voltage

$$I_F = 0.2 A$$

٧F

1,2 V

<

## **CHARACTERISTICS** (continued)

BZD27- XXXX	workir	ng volta V <sub>z</sub>	ge	resi	rential stance		temperature te		current	at reverse voltage VR
		V		1	diff Ω	%/	K	I <sub>Z</sub>	l <sub>R</sub> μA	VR
	min.	typ.	max.	typ.	max.	min.	max.	11/1	max.	
C3V9 C4V3 C4V7 C5V1 C5V6	3,7 4,0 4,4 4,8 5,2	3,9 4,3 4,7 5,1 5,6	4,1 4,6 5,0 5,4 6,0	4 4 3 3 2	8 7 7 6 4	-0,14 -0,12 -0,10 -0,08 -0,04	-0,04 -0,02 0 0,02 0,04	100 100 100 100 100	- - 100 50	- - 2 2
C6V2 C6V8 C7V5 C8V2 C9V1	5,8 6,4 7,0 7,7 8,5	6,2 6,8 7,5 ·8,2 9,1	6,6 7,2 7,9 8,7 9,6	2 1 1 1 2	3 3 2 2 4	-0,01 0 0 0,03 0,03	0,06 0,07 0,07 0,08 0,08	100 100 100 100 50	20 200 50 10 5	2 3 3 5
C10 C11 C12 C13 C15	9,4 10,4 11,4 12,4 13,8	10,0 11,0 12,0 13,0 15,0	10,6 11,6 12,7 14,1 15,6	2 4 4 5 5	4 7 7 10 10	0,05 0,05 0,05 0,05 0,05	0,09 0,10 0,10 0,10 0,10	50 50 50 50 50	7 3 2 2 1	7,5 8,2 9,1 10 11
C16 C18 C20 C22 C24	15,3 16,8 18,8 20,8 22,8	16,0 18,0 20,0 22,0 24,0	17,1 19,1 21,2 23,3 25,6	6 6 6 6 7	15 15 15 15 15	0,06 0,06 0,06 0,06 0,06	0,11 0,11 0,11 0,11 0,11	25 25 25 25 25 25	1 1 1 1	12 13 15 16 18
C27 C30 C33 C36 C39	25,1 28 31 34 37	27,0 30 33 36 39	28,9 32 35 38 41	7 8 8 21 21	15 15 15 40 40	0,06 0,06 0,06 0,06 0,06	0,11 0,11 0,11 0,11 0,11	25 25 25 10 10	1 1 1 1	20 22 24 27 30
C43 C47 C51 C56 C62	40 44 48 52 58	43 47 51 56 62	46 50 54 60 66	24 24 25 25 25	45 45 60 60 80	0,07 0,07 0,07 0,07 0,08	0,12 0,12 0,12 0,12 0,13	10 10 10 10 10	1 1 1 1	33 36 39 43 47
C68 C75 C82 C91 C100	64 70 77 85 94	68 75 82 91 100	72 79 87 96 106	25 30 30 60 60	80 100 100 200 200	0,08 0,08 0,08 0,09 0,09	0,13 0,13 0,13 0,13 0,13	10 10 10 5 5	1 1 1 1	51 56 62 68 75
C110 C120 C130 C150 C160	104 114 124 138 153	110 120 130 150 160	116 127 141 156 171	80 80 110 130 150	250 250 300 300 350	0,09 0,09 0,09 0,09 0,09	0,13 0,13 0,13 0,13 0,13	5 5 5 5 5	1 1 1 1	82 91 100 110 120
C180 C200 C220 C240 C270	168 188 208 228 251	180 200 220 240 270	191 212 233 256 289	180 200 350 400 450	400 500 750 850 1000	0,09 0,09 0,09 0,09 0,09	0,13 0,13 0,13 0,13 0,13	5 5 2 2 2	1 1 1 1 1	130 150 160 180 200

Diodes in the voltage range 300 V to 510 V available on request.

# SILICON PLANAR VOLTAGE REGULATOR DIODES

Silicon planar voltage regulator diodes, in a SOT-89 plastic envelope, intended for stabilization applications in thick and thin-film circuits.

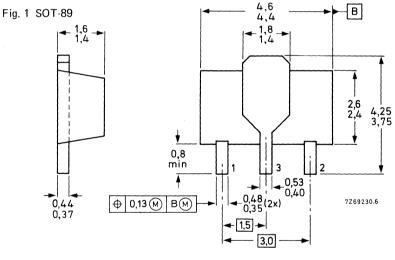
The series covers the normalized range of nominal working voltages from 2,4 V to 75 V with a tolerance of  $\pm$  5% (international standard E24 range).

### QUICK REFERENCE DATA

Working voltage range	$V_{Z}$	nom.	2,4 to 75	V
Working voltage tolerance (E24 range)			±5	%
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	1	W
Junction temperature	Ti	max.	150	оС

### **MECHANICAL DATA**

Dimensions in mm





### Marking code

### BOTTOM VIEW

BZV49- C2V4 = 2Y4 C2V7 = 2Y7 C3V0 = 3Y0 C3V3 = 3Y3 C3V6 = 3Y6 C3V9 = 3Y9 C4V3 = 4Y3 C4V7 = 4Y7	C5V1 = 5Y1 C5V6 = 5Y6 C6V2 = 6Y2 C6V8 = 6Y8 C7V5 = 7Y5 C8V2 = 8Y2 C9V1 = 9Y1 C10 = 10Y C11 = 11Y	C12 = 12Y C13 = 13Y C15 = 15Y C16 = 16Y C18 = 18Y C20 = 20Y C22 = 22Y C24 = 24Y C27 = 27Y	C33 = 33Y C36 = 36Y C39 = 39Y C43 = 43Y C47 = 47Y C51 = 51Y C56 = 56Y C62 = 62Y C68 = 68Y
	011 - 111	C30 = 30Y	C75 = 75Y

# BZV49 SERIES

# **RATINGS**

RATINGS						
Limiting values in acc	cordance with the Absolut	e Maximum Sys	tem (IEC 1	34)		
Repetitive peak forw	ard current		FRM	max.	250	mΑ
Average forward curr (averaged over any			lF(AV)	max.	250	mA
Working current (d.c	.)		IZ	limited by	/ P <sub>tot</sub>	max
Total power dissipati up to T <sub>amb</sub> = 25 <sup>c</sup>			P <sub>tot</sub>	max.		W
Non-repetitive peak r $T_i = 25$ °C; $t_p = 10$	everse power dissipation * 30 μs		Pzsm	max.	40	W
Storage temperature			T <sub>stg</sub>	–65 to	+150	οС
Junction temperature	2		T <sub>j</sub>	max.	150	оС
THERMAL RESISTA	ANCE					
From junction to col	lector tab		R <sub>th j-tab</sub>	=	15	K/W
From junction to am	bient in free air *		R <sub>th j-a</sub>	=	125	K/W
CHARACTERISTICS	5					
T <sub>j</sub> = 25 °C						
Forward voltage IF = 50 mA			V <sub>F</sub>	<	1,0	V
Reverse current BZV49- C2V4 C2V7 C3V0 C3V3	V <sub>R</sub> = 1 V V <sub>R</sub> = 1 V V <sub>R</sub> = 1 V V <sub>R</sub> = 1 V		I <sub>R</sub> I <sub>R</sub>	< < < < < < <	20 10	μΑ μΑ μΑ μΑ
C3V6	V <sub>R</sub> = 1 V		<sup>I</sup> R <sup>I</sup> R	<		μA
C3V9 C4V3 C4V7 C5V1 C5V6	V <sub>R</sub> = 1 V V <sub>R</sub> = 1 V V <sub>R</sub> = 2 V V <sub>R</sub> = 2 V V <sub>R</sub> = 2 V		IR IR IR IR	< < < < < < < < <	3 3 3 2	μΑ μΑ μΑ μΑ
C6V2 C6V8 C7V5 C8V2 C9V1 C10	$V_{R} = 4 V$ $V_{R} = 4 V$ $V_{R} = 5 V$ $V_{R} = 5 V$ $V_{R} = 6 V$ $V_{R} = 7 V$		R   R   R   R   R	< < < < < < < < < < < < < < < < < < <	2	nΑ
C11 to C7 C15 to C7	13 V <sub>R</sub> = 8 V		IR IR	< 7	100	

<sup>\*</sup> Device mounted on a ceramic substrate: area = 2,5 cm²; thickness = 0,7 mm.

 $T_j = 25$  °C E24 logarithmic range (tolerance  $\pm$  5%)

LZ T TOGUTT	timino rang	o (coloranc	,						
BZV49	working	voltage	1	erential stance	tempera	ature coeff	icient	diode car	pacitance
	V7 (	(1/)		$_{ff}\left( \Omega\right)$	Sz	(mV/K)		Ca(pF):	f = 1 MHz
		t = 5 mA	at late	st = 5 mA		Z <sub>test</sub> = 5 n	nΑ	VR	
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.
00)/4	0.0	0.0	70	100	2.5	1.0	0	375	450
C2V4	2,2	2,6	70	100	-3,5	-1,6	0	350	450 450
C2V7	2,5	2,9	75	100	-3,5	-2,0	0	350	450 450
C3V0	2,8	3,2	80	95	-3,5	-2,1		1	450 450
C3V3	3,1	3,5	85	95	-3,5	-2,4 -2,4	0 0	325 300	450 450
C3V6	3,4	3,8	85	90	-3,5	-		1	
C3V9	3,7	4,1	85	90	-3,5	-2,5	0	300	450
C4V3	4,0	4,6	80	90	-3,5	-2,5	0	275	450
C4V7	4,4	5,0	50	80	-3,5	-1,4	0,2	130	180
C5V1	4,8	5,4	40	60	-2,7	-0,8	1,2	110	160
C5V6	5,2	6,0	15	40	-2,0	1,2	2,5	95	140
C6V2	5,8	6,6	6	10	0,4	2,3	3,7	90	130
C6V8	6,4	7,2	6	15	1,2	3,0	4,5	85	110
C7V5	7,0	7,9	6	15	2,5	4,0	5,3	80	100
C8V2	7,7	8,7	6	15	3,2	4,6	6,2	75	95
C9V1	8,5	9,6	6	15	3,8	5,5	7,0	70	90
C10	9,4	10,6	8	20	4,5	6,4	8,0	70	90
C11	10,4	11,6	10	20	5,4	7,4	9,0	65	85
C12	11,4	12,7	10	25	6,0	8,4	10,0	65	85
C13	12,4	14,1	10	30	7,0	9,4	11,0	60	80
C15	13,8	15,6	10	30	9,2	11,4	13,0	55	75
C16	15,3	17,1	10	40	10,4	12,4	14,0	52	75
C18	16,8	19,1	10	45	12,4	14,4	16,0	47	70
C20	18,8	21,2	15	55	14,4	16,4	18,0	36	60
C22	20,8	23,3	20	55	16,4	18,4	20,0	34	60
C24	22,8	25,6	25	70	18,4	20,4	22,0	33	55
							•		
	at IZtes	t = 2 mA	at IZte	st = 2 mA	at I	Ztest = 2 r	nΑ		
C27	25,1	28,9	25	80	21,4	23,4	25,3	30	50
C30	28,0	32,0	30	80	24,4	26,6	29,4	27	50
C33	31,0	35,0	35	80	27,4	29,7	33,4	25	45
C36	34,0	38,0	35	90	30,4	33,0	37,4	23	45
C39	37,0	41,0	40	130	33,4	36,4	41,2	21	45
C43	40,0	46,0	45	150	37,6	41,2	46,6	21	40
C47	44,0	50,0	50	170	42,0	46,1	51,8	19	40
C51	48,0	54,0	60	180	46,6	51,0	57,2	19	40
C56	52,0	60,0	70	200	52,2	57,O	63,8	18	40
C62	58,0	66,0	80	215	58,8	64,4	71,6	17	35
C68	64,0	72,0	90	240	65,6	71,7	79,8	17	35
C75	70,0	79,0	95	255	73,4	80,2	88,6	16,5	35
	/-	, -	1		1			1	

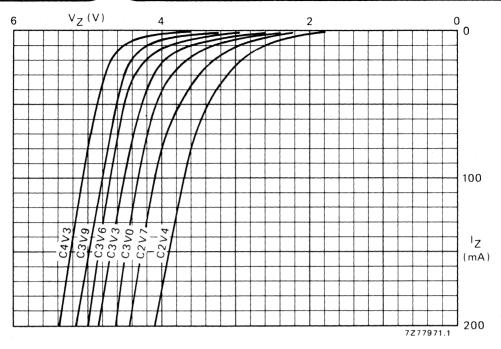


Fig. 2 Dynamic characteristics; typical values;  $T_j = 25$  °C.

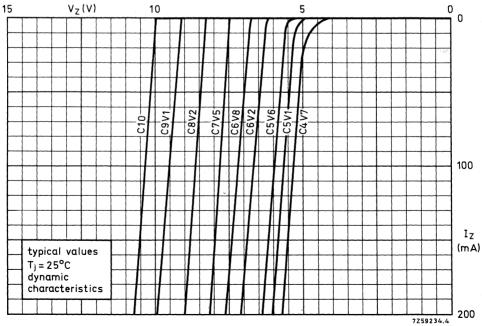


Fig. 3 Dynamic characteristics; typical values at  $T_j$  = 25  $^{o}\text{C}$ .

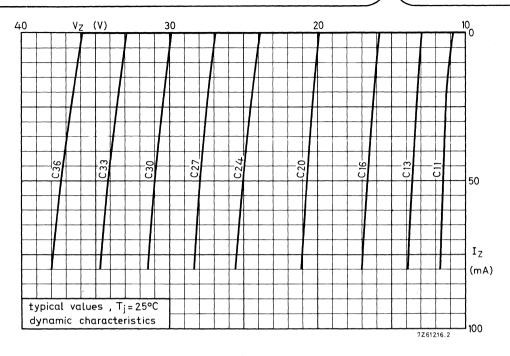


Fig. 4 Dynamic characteristics; typical values;  $T_i = 25$  °C.

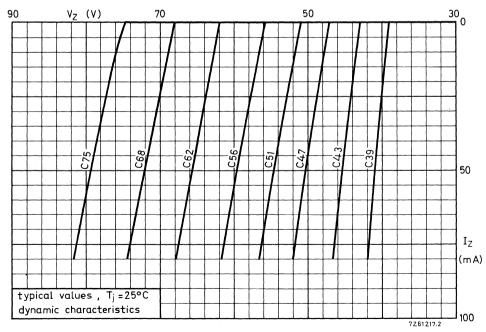


Fig. 5 Dynamic characteristics; typical values at  $T_i = 25$  °C.

## Model for calculating the static working voltage (VZ stat).

This model can be derived from  $V_{Z \text{ stat}} = V_{Z \text{ dyn}} + \Delta V_{Z}$  of which  $V_{Z \text{ dyn}}$  is given in the preceding tables and can be derived from the typical dynamic characteristic curves (Figs 2, 3, 4 and 5)

$$\Delta V_Z = \Delta T \times S_Z$$
. For  $S_Z$  see tables and graphs  $S_Z$  versus  $T_j$ .

$$\Delta T = P_{tot} \times R_{th j-a} = I_Z \times V_{Z dyn} \times R_{th j-a}$$

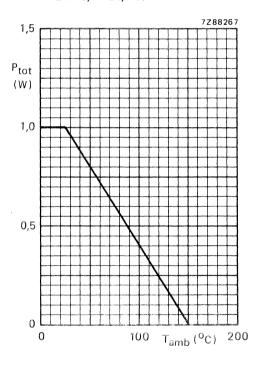
 $\Delta T = P_{tot} \times R_{th} \cdot j_{-a} = I_Z \times V_{Z dyn} \times R_{th} \cdot j_{-a}$ . Following  $\Delta V_Z = I_Z \times V_{Z dyn} \times R_{th} \cdot j_{-a} \times S_Z$  and the model will be:

$$V_{Z \text{ stat}} = V_{Z \text{ dyn}} + I_{Z} \times V_{Z \text{ dyn}} \times R_{th \text{ j-a}} \times S_{Z}$$

### Calculating example

BZV49-C24 mounted on a ceramic substrate of  $7 \times 5 \times 0.6$  mm; at  $I_Z = 7$  mA.

$$V_{Z \text{ stat}} = 24 + (\frac{7}{1000} \times 24 \times \frac{125}{1000} \times 20,3)$$
  
= 24 + 0,4 = 24,4 V.



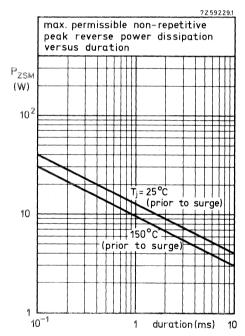


Fig. 6 Power derating curve.

Fig. 7.

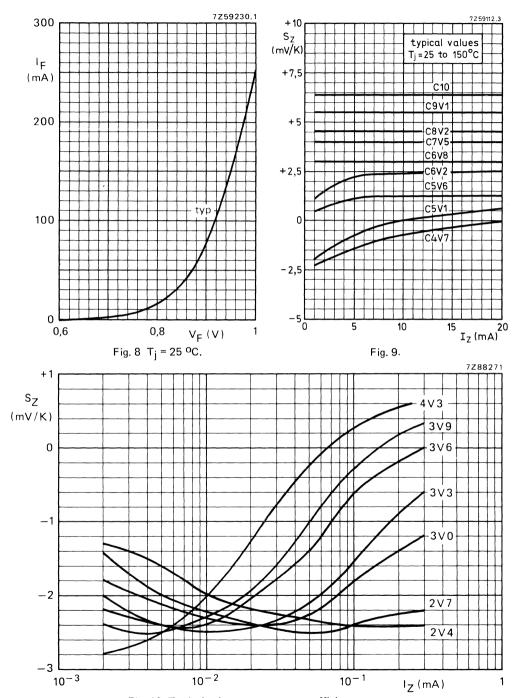
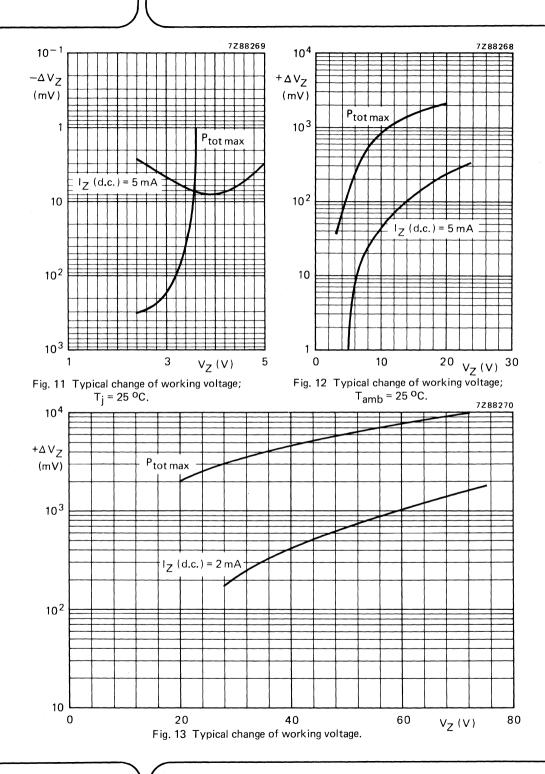


Fig. 10 Typical values temperature coefficient.



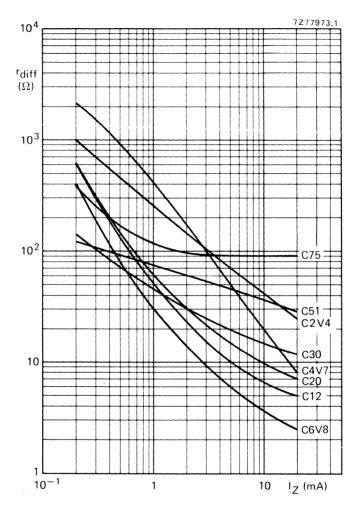


Fig. 14 Typical values;  $T_j = 25$  °C; f = 1 kHz.

# **DEVELOPMENT DATA**

This data sheet contains advance information and specifications are subject to change without notice.

# VOLTAGE REGULATOR DIODES FOR SURFACE MOUNTING

Silicon planar diodes designed for use as low-voltage stabilizers or voltage references. They are available in the international standardized E24 ( $\pm$ 5%) range. The series consists of 37 types with nominal working voltages ranging from 2,4 V to 75 V.

The SM diode is a leadless diode in an hermetically sealed glass SOD-80 envelope with tinplated metal discs at each end. It is suitable for "automatic placement" and as such it can withstand immersion soldering.

The diodes are delivered in "super 8" tape.

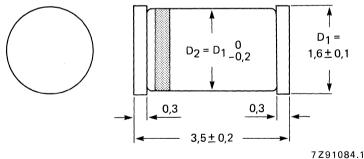
#### QUICK REFERENCE DATA

Working voltage range	$V_{Z}$	nom. 2,4	to 75	٧
Total power dissipation up to				
flange temperature of 50 °C	$P_{tot}$	max.	500	mW
Non-repetitive peak reverse power dissipation	PZSM	max.	30	W
Junction temperature	Tj	max.	200	oC
Thermal resistance from junction to tie-point	R <sub>th j-tp</sub>	=	0,30	K/mW

### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOD-80.



The BZV55 cathode is indicated by a yellow band.

# BZV55 SERIES

RA	T	N	G	S

HATHIGO						
Limiting values in accord	lance with the Absolute	e Maximum System	(IEC 134).			
Average forward current over any 20 ms period			l <sub>F(AV)</sub>	max.	250	mA
Repetitive peak forward			I <sub>FRM</sub>	max.	250	
Total power dissipation	darrone		LUIVI	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
up to T <sub>flange</sub> = 50 °C			P <sub>tot</sub>	max.	500	mW
up to T <sub>amb</sub> = 50 °C a substrate of 10 mm x	nd mounted on a ceran 10 mm × 0,6 mm	nic	P <sub>tot</sub>	max.	400	mW
Non-repetitive peak reverse $t = 100 \mu s$ ; $T_i = 150 \circ t$			PZSM	max.	30	W
Storage temperature			T <sub>stq</sub>	65 to	+ 200	оС
Junction temperature			T <sub>i</sub>	max.	200	оС .
•			j			
THERMAL RESISTANC	CE					
From junction to tie-poi	nt (flanges)		R <sub>th j-tp</sub>	=	0,30	K/mW
From junction to ambier substrate of 10 mm x		ceramic	R <sub>th j-a</sub>	= 1	0,38	K/mW
CHARACTERISTICS						
T <sub>i</sub> = 25 °C unless otherw	vise specified					
Forward voltage			۷ <sub>F</sub>	< 1	0,9	٧
Reverse current						
BZV552V4	$V_R = 1 V$		ļR	< 1		μΑ
.2V7	V <sub>R</sub> = 1 V		I <sub>R</sub>	< 1 × 1 × 1 × 1 × 1 × 1 × 1 × 1 × 1 × 1		μΑ μΑ
.3V0 .3V3	V <sub>R</sub> = 1 V V <sub>R</sub> = 1 V		I <sub>R</sub> I <sub>R</sub>	2		μA
.3V6	V <sub>R</sub> = 1 V		I <sub>R</sub>	< 1 c		μΑ
.3V9	V <sub>R</sub> = 1 V		I <sub>R</sub>	<	3	μΑ
.4V3	V <sub>R</sub> = 1 V		I <sub>R</sub>	< < <		μΑ
.4V7	$V_R = 2 V$		!R	<		μΑ
.5V1	V <sub>R</sub> = 2 V		I <sub>R</sub>	< <		μA μA
.5V6 .6V2	$V_R = 2 V$ $V_R = 4 V$		<sup>1</sup> R	<		μA
.6V8	V <sub>R</sub> = 4 V		I <sub>R</sub> I <sub>R</sub>	<		μA
.7V5	V <sub>R</sub> = 5 V		¹R	<		μΑ
.8V2	V <sub>R</sub> = 5 V		IR	< <	700	
.9V1	$V_R = 6 V$		۱R		500	nΑ
.10	$V_R = 7 V$		<sup>I</sup> R	<		nΑ
.11 to .13	V <sub>R</sub> = 8 V		l <sub>R</sub>	<		nA
.15 to .75 . = C for E24	$V_R = 0.7 V_{Znom}$ (± 5%) tolerance		1 <sub>R</sub>	<	50	nA

 $T_j = 25$  °C E24 (± 5%) logarithmic range

**DEVELOPMENT DATA** 

BZV55	working voltage		differential resistance $r_{ m diff}\left(\Omega ight)$		cc S <sub>2</sub>	mperati pefficier Z (mV/	diode capacitance C <sub>d</sub> (pF) at f = 1 MHz		
	at IZtest min.	= <b>5 mA</b> max.	at IZtest typ.	= <b>5 mA</b> max.	at I <sub>Z</sub> min.	test = 5 typ.	mA max.	typ.	= <b>0</b> max.
C2V4 C2V7	2,2 2,5	2,6 2,9	70 75	100 100	-3,5 -3,5	-1,6 -2,0	0	375 350	450 450
C3V0	2,8	3,2	80	95	-3,5	-2,1	Ö	350	450
C3V3	3,1	3,5	85	95	-3,5	-2,4	0	325	450
C3V6	3,4	3,8	85	90	-3,5	-2,4	0	300	450
C3V9	3,7	4,1	85	90	-3,5	-2,5	0	300	450
C4V3	4,0	4,6	80	90	-3,5	-2,5	0	275	450
C4V7	4,4	5,0	50	80	-3,5 -2,7	-1,4 -0,8	0,2 1,2	125 125	180 180
C5V1 C5V6	4,8 5,2	5,4 6,0	40 15	60 40	-2,7 -2,0	1,2	2,5	125	180
C6V2	5,8	6,6	6	10	0.4	2,3	3,7	90	130
C6V8	6,4	7,2	6	15	1,2	3,0	4,5	85	110
C7V5	7,0	7,9	6	15	2,5	4,0	5,3	80	100
C8V2	7,7	8,7	6	15	3,2	4,6	6,2	75	95
C9V1	8,5	9,6	6	15	3,8	5,5	7,0	70	90
C10	9,4	10,6	8	20	4,5	6,4	8,0	70	90
C11	10,4	11,6	10	20	5,4	7,4	9,0	65	85
C12	11,4	12,7	10	25	6,0 7,0	8,4 9,4	10,0 11,0	65 60	85 80
C13 C15	12,4 13,8	14,1 15,6	10 10	30 30	9,2	11,4	13,0	55	75
C16	15,3	17,1	10	40	10,4	12,4	14,0	52	75
C18	16,8	19,1	10	45	12,4	14,4	16,0	47	70
C20	18,8	21,2	15	55	14,4	16,4	18,0	36	60
C22	20,8	23,3	20	55	16,4	18,4	20,0	34	60
C24	22,8	25,6	25	70	18,4	20,4	22,0	33	55
	at IZtest	= 2 mA	at I Ztest	= 2 mA	at I <sub>Z</sub>	test = 2	2 mA		
C27	25,1	28,9	25	80	21,4	23,4	25,3	30	50
C30	28,0	32,0	30	80	24,4	26,6	29,4	27	50
C33	31,0	35,0	35	80	27,4	29,7	33,4	25	45
C36 C39	34,0 37,0	38,0	35 40	90 130	30,4 33,4	33,0 36,4	37,4 41,2	23	45 45
		41,0				41,2	46,6	21	40
C43 C47	40,0 44,0	46,0 50,0	45 50	150 170	37,6 42,0	46,1	46,6 51,8	19	40
C51	48,0	54,0	60	180	46,6	51,0	57,2	19	40
C56	52,0	60,0	70	200	52,2	57,0	63,8	18	40
C62	58,0	66,0	80	215	58,8	64,4	71,6	17	35
C68	64,0	72,0	90	240	65,6	71,7	79,8	. 17	35
	70,0	79,0	95	255	73,4	80.2	88,6	16,5	35

# **BZV55 SERIES**

 $T_j = 25$  °C E24 (± 5%) logarithmic range

BZV55	\ at	(ing vol (Z (V) IZ = 1 n	ıΑ	resist rdiff at I <sub>Z</sub> =	ential tance (Ω) = 1 mA	at I	king vol $V_{Z}(V)$ $Z = 20 i$	nΑ	resis rdif at IZ =	
	min.	nom.	max.	typ.	max.	min.	nom.	max.	typ.	max.
C2V4	1,7	1,9	2,1 2,4	275 300	600 600	2,6 3,0	2,9 3,3	3,2 3,6	25 25	50 50
C2V7 C3V0	1,9 2,1	2,2 2,4	2,4 2,7	325	600	3,3	3,5 3,6	3,9	25	50
C3V3	2,3	2,4	2,7	350	600	3,6	3,9	4,2	20	40
C3V6	2,7	3,0	3,3	375	600	3,9	4,2	4,5	20	40
C3V9	2,9	3,2	3,5	400	600	4,1	4,4	4,7	15	30
C4V3	3,3	3,6	4,0	410	600	4,4	4,7	5,1	15	30
C4V7	3,7	4,2	4,7	425	500	4,5	5,0	5,4	8	15
C5V1	4,2	4,7	5,3	400	480	5,0	5,4	5,9	6	15
C5V6	4,8	5,4	6,0	80	400	5,2	5,7	6,3	4	10
C6V2	5,6	6,1	6,6	40	150	5,8	6,3	6,8	3	6
C6V8	6,3	6,7	7,2	30	80	6,4	6,9	7,4	2,5	6
C7V5	6,9	7,4	7,9	30	80	7,0	7,6	8,0	2,5	6
C8V2	7,6	8,1	8,7	40	80	7,7	8,3	8,8	3	6 8
C9V1	8,4	9,0	9,6	40	100	8,5	9,2	9,7	4	
C10	9,3	9,9	10,6	50	150	9,4	10,1	10,7	4	10
C11	10,2	10,9	11,6	50	150	10,4	11,1	11,8 12,9	5	10 10
C12	11,2 12,3	11,9 12,9	12,7 14,0	50 50	150 170	11,4 12,5	12,1 13,1	14,2	5	15
C13 C15	13,7	14,9	15,5	50	200	13,9	15,1	15,7	6	20
	ì		17,0	50	200	15,4	16,1	17,2	6	20
C16 C18	15,2 16,7	15,9 17,9	19,0	50	225	16,9	18,1	19,2	6	20
C20	18,7	19,9	21,1	60	225	18,9	20,1	21,4	7	20
C22	20,7	21,9	23,2	60	250	20,9	22,1	23,4	7	25
C24	22,7	23,9	25,5	60	250	22,9	24,1	25,7	7	25
	at	I <sub>Z</sub> = 0,1	mA	at IZ=	0,5 mA	at	IZ = 10	mA	at IZ =	10 m
C27	25,0	26,9	28,9	65	300	25,2	27,1	29,3	10	45
C30	27,8	29,9	32,0	70	300	28,1	30,1	32,4	15	50
C33	30,8	32,9	35,0	75	325	31,1	33,1	35,4	20	55
C36	33,8	35,9	38,0	80	350	34,1	36,1	38,4	25	60
C39	36,7	38,9	41,0	80	350	37,1	39,1	41,5	25	70
C43	39,7	42,9	46,0	85	375	40,1	43,1	46,5	25	80
C47	43,7	46,8	50,0	85	375	44,1	47,1	50,5	30 35	90 100
C51	47,6	50,8	54,0	90	400	48,1	51,1	54,6 60,8	45	110
C56	51,5	55,7	60,0	100 120	425 450	52,1 58,2	56,1 62,1	67,0	60	120
C62	57,4	61,7	66,0	1		1		73,2	75	130
C68	63,4	67,7	72,0	150	475 500	64,2 70,3	68,2 75,3	73,2 80,2	90	140
C75	69,4	74,7	79,0	170	500	70,3	, 5,3	00,2	30	1 70

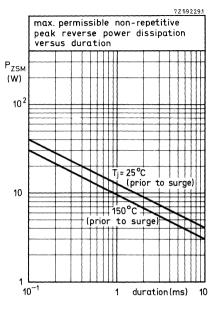
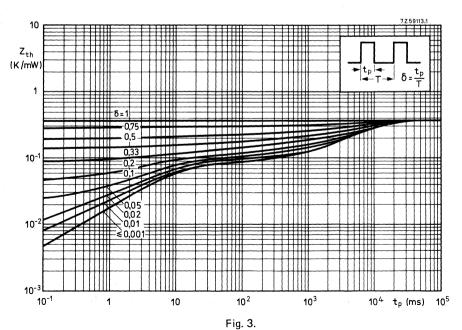


Fig. 2.



Ū

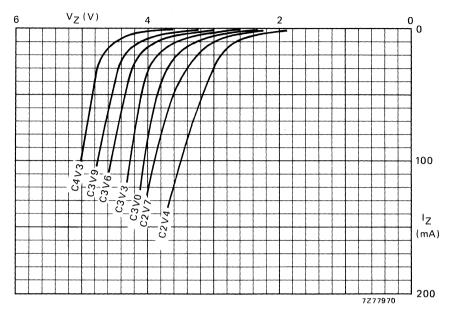


Fig. 4 Static characteristics; typical values;  $T_{amb} = 25$  °C.

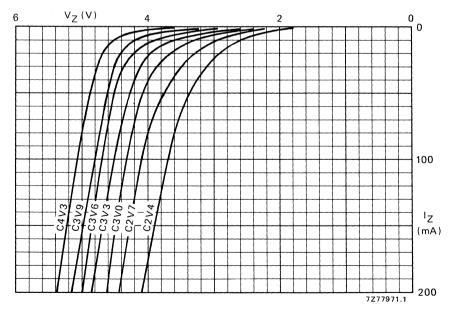


Fig. 5 Dynamic characteristics; typical values;  $T_j = 25$  °C.

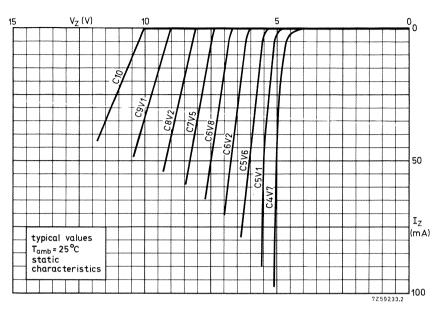


Fig. 6.

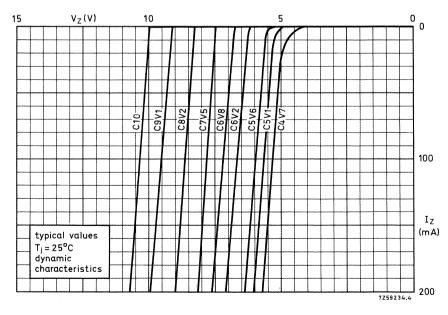


Fig. 7.

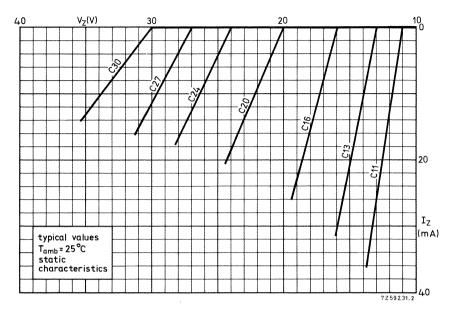


Fig. 8.

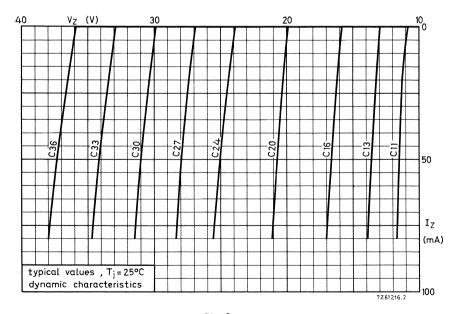


Fig. 9.

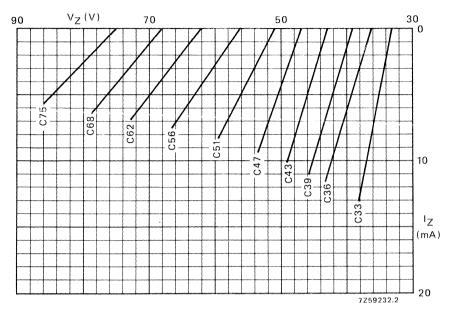


Fig. 10 Static characteristics; typical values;  $T_{amb} = 25$  °C.

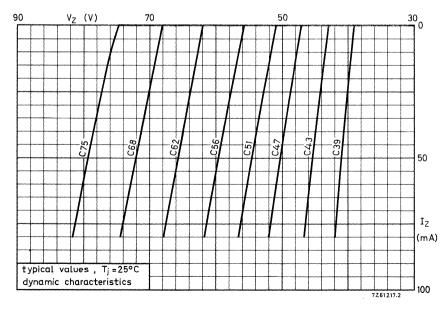


Fig. 11.

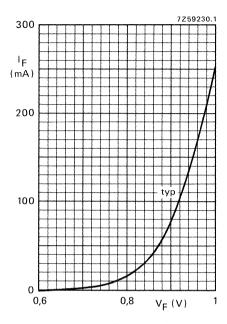


Fig. 12  $T_j = 25$  °C.

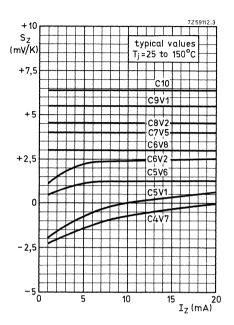


Fig. 13.

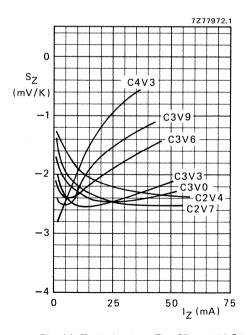


Fig. 14 Typical values;  $T_j = 25$  to 150 °C.

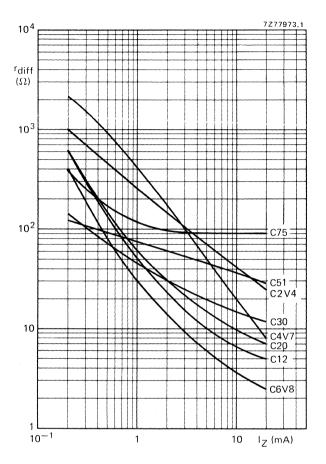


Fig. 15 Typical values;  $T_j = 25$  °C; f = 1 kHz.

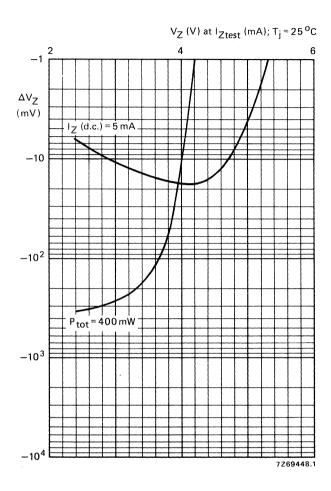


Fig. 16 Typical change of working voltage under operating conditions at  $T_{amb} = 25$  °C.

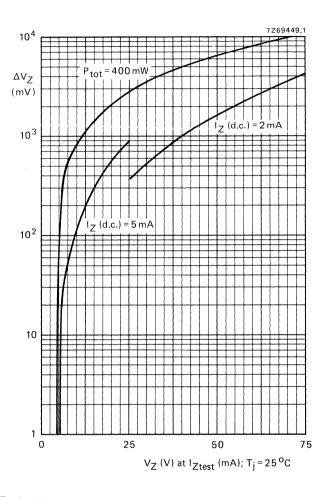


Fig. 17 Typical change of working voltage under operating conditions at  $T_{amb}$  = 25 °C.

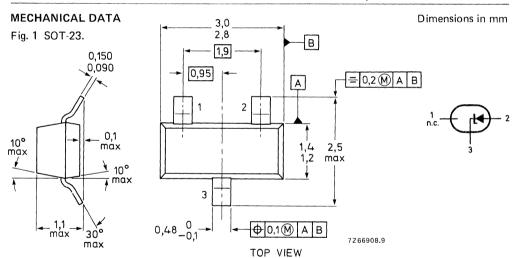


# SILICON PLANAR VOLTAGE REGULATOR DIODES

Low power general purpose voltage regulator diodes in a microminiature plastic envelope intended for application in thick and thin-film circuits. The series covers the normalized range of nominal working voltages from 2,4 V to 75 V with a working voltage tolerance of ± 5%.

### QUICK REFERENCE DATA

Working voltage range	$V_{Z}$	nom.	2,4 to 75 V
Working voltage tolerance			± 5 %
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	350 mW
Junction temperature	$T_{j}$	max.	175 °C



See also Soldering recommendations.

### Marking code

			_
BZX84-C33 = Y12	BZX84-C13 = Y3	BZX84-C5V6 = Z3	BZX84-C2V4 = Z11
C36 = Y13	C15 = Y4	C6V2 = Z4	C2V7 = Z12
C39 = Y14	C16 = Y5	C6V8 = Z5	C3V0 = Z13
C43 = Y15	C18 = Y6	C7V5 = Z6	C3V3 = Z14
C47 = Y16	C20 = Y7	C8V2 = Z7	C3V6 = Z15
C51 = Y17	C22 = Y8	C9V1 = Z8	C3V9 = Z16
C56 = Y18	C24 = Y9	C10 = Z9	C4V3 = Z17
C62 = Y19	C27 = Y10	C11 = Y1	C4V7 = Z1
C68 = Y20	C30 = Y11	C12 = Y2	C5V1 = Z2
C75 = V21			

### RATINGS

	Limiting values in accordance with the Absolute Maximum System (IEC	C 134)			
	Repetitive peak forward current	FRM	max.	250	mΑ
	Repetitive peak working current	IZRM	max.	250	mA
	Total power dissipation up to T <sub>amb</sub> = 25 °C**	P <sub>tot</sub>	max.	350	mW
	Storage temperature	T <sub>stg</sub>	-65 to +		
	Junction temperature	Ti	max.	175	
	THERMAL CHARACTERISTICS*				
	$T_j = P \times (R_{th \ j-t} + R_{th \ t-s} + R_{th \ s-a}) + T_{amb}$				
	Thermal resistance				
	From junction to tab	R <sub>th j-t</sub>	= ,	50	K/W
	From tab to soldering points	R <sub>th t-s</sub>	22	280	K/W
	From soldering points to ambient**	R <sub>th s-a</sub>	=	90	K/W
	CHARACTERISTICS .				
	T <sub>j</sub> = 25 °C unless otherwise specified				
	Forward voltage				
	I <sub>F</sub> = 10 mA	٧F	< 1	0,9	V
	Reverse current				-
,	$BZX84-C2V4 \qquad V_{R} = 1 V$	IR	<		μA -
	$\begin{array}{cccc} C2V7 & V_R = 1 \ V \\ C3V0 & V_R = 1 \ V \end{array}$	IR	<		μA μA
	C3V3 $V_B = 1 V$	I <sub>R</sub> I <sub>R</sub>	2		μA
	$V_R = 1$ V $V_R = 1$ V	rk I <sub>R</sub>	~		μA
	C3V9 V <sub>R</sub> = 1 V	I <sub>R</sub>	<		μΑ
	C4V3 $V_R = 1 V$	I'R	<		μA
	C4V7 $V_R = 2 V$	I <sub>R</sub>	<	3	μΑ
	C5V1 $V_R = 2 V$	I <sub>R</sub>	<	2	μΑ
	$V_R = 2 V$	l <sub>R</sub>	<	1	μΑ
	$V_R = 4 V$	1 <sub>R</sub>	<	3	μΑ
	C6V8 $V_R = 4 V$	l <sub>R</sub>	<		μΑ
	$C7V5$ $V_R = 5 V$	<sup>l</sup> R	<u> </u>		μΑ
	$C8V2 \qquad V_R = 5 V$	<sup>l</sup> R	<	700	
	$C9V1 \qquad V_R = 6 V$	l <sub>R</sub>	<,	500	
	$V_R = 7 V$	l <sub>R</sub>	< < < < < < < < < < < < < < < < < < <	200	
	C11 $V_R = 8 V$ C12 $V_R = 8 V$	I <sub>R</sub>		100 100	
	C12 $V_R = 8 V$ C13 $V_B = 8 V$	lR	2	100	
	C15 to C75 $V_R = 0.7 V_{Znom}$	I <sub>R</sub> I <sub>R</sub>	<		nA
	. n 9// . Zhoili	·n	•		•

<sup>\*</sup> See Thermal characteristics.

<sup>\*\*</sup> Device mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

BZX84	working	g voltage		erential stance	temper	ature coe	efficient	diode c	apacitance	
	Vz	(V)		$_{ff}\left( \Omega  ight)$	! {	S7 (mV/k	()	C <sub>d</sub> (pF)	:f = 1 MHz; -	•
	at Iztes	t = 5 mA	1	st = 5 mA	at I	Ztest = 5	mA	V	R = 0	
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.	
C2V4	2,2	2,6	70	100	-3,5	-1,6	0	375	450	
C2V7	2,5	2,9	75	100	-3,5	2.0	0	350	450	
C3V0	2,8	3,2	80	95	3,5	2,1	0	350	450	
C3V3	3,1	3,5	85	95	3,5	2,4	0	325	450	
C3V6	3,4	3,8	85	90	3,5	2,4	0	300	450	
C3V9	3,7	4,1	85	90	-3,5	2,5	0	300	450 🕶	
C4V3	4,0	4,6	80	90	-3,5	2,5	0	275	450	
C4V7	4,4	5,0	50	80	-3,5	1,4	0,2	245	300	
C5V1	4,8	5,4	40	60	-2,7	-0.8	1,2	235	300	
C5V6	5,2	6,0	15	40	-2,0	1,2	2,5	225	300	
C6V2	5,8	6,6	6	10	0,4	2,3	3,7	125	200	
C6V8	6,4	7,2	6	15	1,2	3,0	4,5	105	200	
C7V5	7,0	7,9	6	15	2,5	4,0	5,3	95	150	
C8V2	7,7	8,7	6	15	3,2	4,6	6,2	90	150	
C9V1	8,5	9,6	6	15	3,8	5,5	7,0	70	150	
C10	9,4	10,6	8	20	4,5	6,4	8,0	70	90	
C11	10.4	11,6	10	20	5,4	7,4	9,0	65	85	
C12	11,4	12,7	10	25	6,0	8,4	10,0	65	85	
C13	12,4	14,1	10	30	7,0	9,4	11,0	60	80	
C15	13,8	15,6	10	30	9,2	11,4	13,0	55	75	
C16	15,3	17,1	10	40	10,4	12.4	14,0	52	75	
C18	16,8	19,1	10	45	12,4	14,4	16,0	47	70	
C20	18,8	21,2	15	55	14,4	16,4	18,0	36	60	
C22	20,8	23,3	20	55	16,4	18,4	20,0	34	60	
C24	22,8	25,6	25	70	18,4	20,4	22,0	33	55	
	at IZ =	. 2 4	-41	= 2 mA		I <sub>Z</sub> = 2 m	^			
	_									
	min.	max.	typ.	max.	min.	typ.	max.	typ.	max.	
C27	25,1	28,9	25	80	21,4	23,4	25,3	30	50	
C30	28,0	32,0	30	80	24,4	26,6	29,4	. 27	50	
C33	31,0	35,0	35	80	27,4	29,7	33,4	25	45	
C36	34,0	38,0	35	90	30,4	33,0	37,4	23	45	
C39	37,0	41,0	40	130	33,4	36,4	41,2	21	45	
C43	40,0	46,0	45	150	37,6	41,2	46,6	21	40	
C47	44,0	50,0	50	170	42,0	46,1	51,8	19	40	
C51	48,0	54,0	60	180	46,6	51,0	57,2	19	40	
C56	52,0	60,0	70	200	52,2	57,0	63,8	18	40	
C62	58,0	66,0	80	215	58,8	64,4	71,6	17	35	
C68	64,0	72,0	90	240	65,6	71,7	79,8	17	35	
C75	70,0	79,0	95	255	73,4	80,2	88,6	16,5	35	
	1		1	ì				1		

BZX84	wo	rking vol	tage	1	rential tance	work	ing voltaç	je		rential tance
		$V_Z(V)$		rdiff			$V_Z(V)$			$f(\Omega)$
	at	t I <sub>Z</sub> = 1 r	nA	1	= 1 mA	at	I <sub>Z</sub> = 20 r	nA		20 mA
	min.	nom.	max.	typ.	max.	min.	nom.	max.	typ.	max.
C2V4 C2V7 C3V0 C3V3 C3V6	1,7 1,9 2,1 2,3 2,7	1,9 2,2 2,4 2,6 3,0	2,1 2,4 2,7 2,9 3,3	275 300 325 350 375	600 600 600 600	2,6 3,0 3,3 3,6 3,9	2,9 3,3 3,6 3,9 4,2	3,2 3,6 3,9 4,2 4,5	25 25 25 20 20	50 50 50 40 40
C3V9 C4V3 C4V7 C5V1 C5V6	2,9 3,3 3,7 4,2 4,8	3,2 3,6 4,2 4,7 5,4	3,5 4,0 4,7 5,3 6,0	400 410 425 400 80	600 600 500 480 400	4,1 4,4 4,5 5,0 5,2	4,4 4,7 5,0 5,4 5,7	4,7 5,1 5,4 5,9 6,3	15 15 8 6 4	30 30 15 15
C6V2 C6V8 C7V5 C8V2 C9V1	5,6 6,3 6,9 7,6 8,4	6,1 6,7 7,4 8,1 9,0	6,6 7,2 7,9 8,7 9,6	40 30 30 40 40	150 80 80 80 100	5,8 6,4 7,0 7,7 8,5	6,3 6,9 7,6 8,3 9,2	6,8 7,4 8,0 8,8 9,7	3 2,5 2,5 3 4	6 6 6 8
C10 C11 C12 C13 C15	9,3 10,2 11,2 12,3 13,7	9,9 10,9 11,9 12,9 14,9	10,6 11,6 12,7 14,0 15,5	50 50 50 50 50	150 150 150 170 200	9,4 10,4 11,4 12,5 13,9	10,1 11,1 12,1 13,1 15,1	10,7 11,8 12,9 14,2 15,7	4 5 5 6	10 10 10 15 20
C16 C18 C20 C22 C24	15,2 16,7 18,7 20,7 22,7	15,9 17,9 19,9 21,9 23,9	17,0 19,0 21,1 23,2 25,5	50 50 60 60	200 225 225 250 250	15,4 16,9 18,9 20,9 22,9	16,1 18,1 20,1 22,1 24,1	17,2 19,2 21,4 23,4 25,7	6 6 7 7 7	20 20 20 25 25
. '	at	I <sub>Z</sub> = 0,1	mA	at IZ=	= 0,5 mA	at	IZ = 10 n	nA	at Iz =	10 mA
C27 C30 C33 C36 C39 C43 C47 C51 C56 C62 C68	min. 25,0 27,8 30,8 33,8 36,7 39,7 43,7 47,6 51,5 57,4 63,4	nom. 26,9 29,9 32,9 35,9 38,9 42,9 46,8 50,8 55,7 61,7	max. 28,9 32,0 35,0 38,0 41,0 46,0 50,0 60,0 66,0 72,0	typ. 65 70 75 80 80 85 85 90 100 120	max. 300 300 325 350 350 375 400 425 450 475	min. 25,2 28,1 31,1 34,1 37,1 40,1 44,1 48,1 52,1 58,2 64,2	nom. 27,1 30,1 33,1 36,1 39,1 43,1 47,1 51,1 56,1 62,1 68,2	max. 29,3 32,4 35,4 38,4 41,5 46,5 50,5 54,6 60,8 67,0 73,2	typ. 10 15 20 25 25 25 30 35 45 60 75	max. 45 50 55 60 70 80 90 100 110 120
C75	69,4	74,7	79,0	170	500	70,3	75,3	80,2	90	140

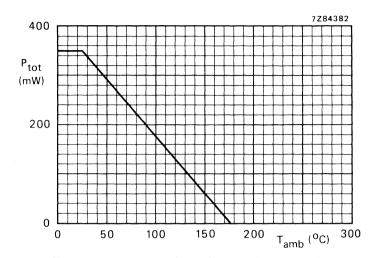


Fig. 2 Power derating curve.

# Model for calculating the static working voltage (V<sub>Z stat</sub>).

This model can be derived from  $V_{Z \text{ stat}} = V_{Z \text{ dyn}} + \Delta V_{Z}$  of which  $V_{Z \text{ dyn}}$  is given in the preceding tables and can be derived from the typical dynamic characteristic curves in Figs 3 to 6.

 $\Delta V_Z = \Delta T \times S_Z$ . For  $S_Z$  see tables and graphs  $S_Z$  versus  $T_i$ .

 $\Delta T = P_{tot} \times R_{th j-a} = I_Z \times V_{Z dyn} \times R_{th j-a}$ Following  $\Delta V_Z = I_Z \times V_{Z dyn} \times R_{th j-a} \times S_Z$  and the model will be:

$$V_{Z \text{ stat}} = V_{Z \text{ dyn}} + I_{Z} \times V_{Z \text{ dyn}} \times R_{th j-a} \times S_{Z}$$

#### Calculating example

BZX84-C24 mounted on a ceramic substrate of 7 x 5 x 0,6 mm; at  $I_Z$  = 7 mA.

$$V_{Z \text{ stat}} = 24 + (\frac{7}{1000} \times 24 \times \frac{430}{1000} \times 20,3)$$
  
= 24 + 1,47 = 25.47 V.

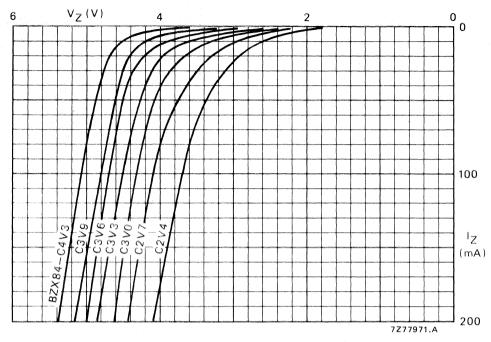


Fig. 3 Dynamic characteristics; typical values;  $T_i = 25$  °C.

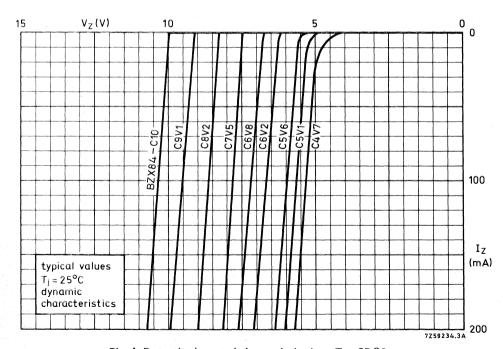


Fig. 4 Dynamic characteristics; typical values;  $T_i = 25$  °C.

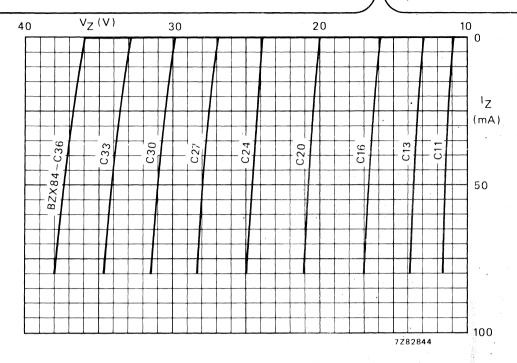


Fig. 5 Dynamic characteristics; typical values;  $T_i = 25$  °C.

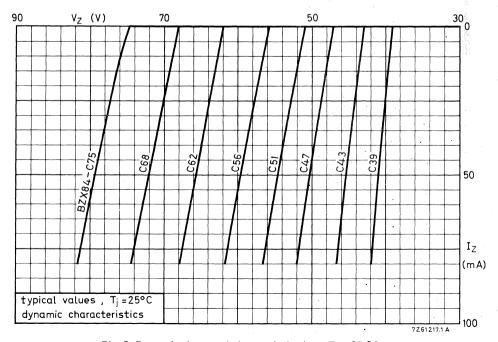


Fig. 6 Dynamic characteristics; typical values;  $T_j = 25$  °C.

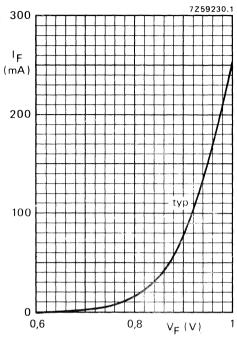


Fig. 7 Typical values at  $T_i = 25$  °C.

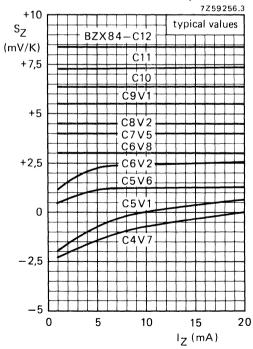


Fig. 9 Typical values;  $T_j = 25$  to 175 °C.

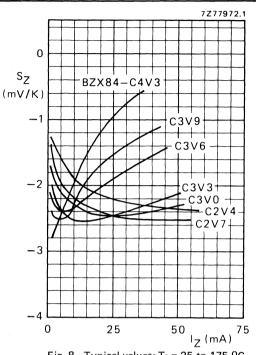


Fig. 8 Typical values;  $T_j = 25$  to 175 °C.

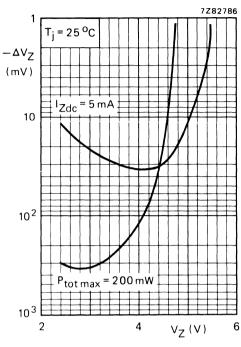
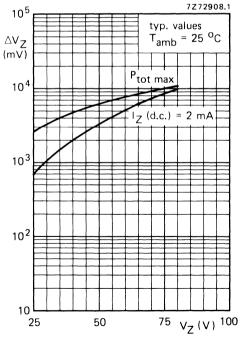


Fig. 10.



 $10^{5}$   $\Delta V_{Z}$   $\Delta V_{$ 

Fig. 12.

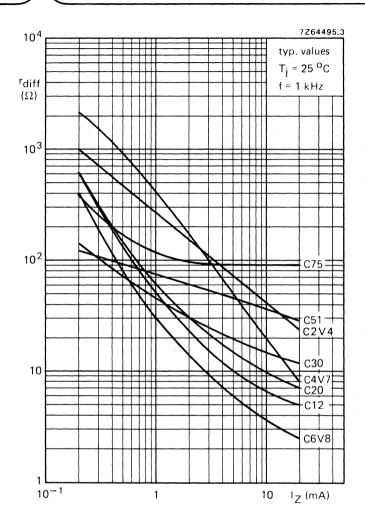


Fig. 13.

### N-CHANNEL FETS

Silicon n-channel depletion type junction field-effect transistors on a plastic microminiature envelope intended for application in thick and thin-film circuits. The transistors are intended for low-power, chopper or switching applications in industry.

### QUICK REFERENCE DATA

		PMBF4391		PMBF4392	PMBF4	1393
Drain-source voltage	± V <sub>DS</sub>	max.	40	40	40	V
Drain current $V_{DS} = 20 V; V_{GS} = 0$	IDSS	>	50	25	5	mA
Gate-source cut-off voltage $V_{DS} = 20 \text{ V}; I_D = 1 \text{ nA}$	-V <sub>(P)GS</sub>	> <	4 10	2 5	0,5 3	V V
Drain-source resistance (on) at $f = 1 \text{ kHz}$ $I_D = 1 \text{ mA}$ ; $V_{GS} = 0$	<sup>r</sup> ds on	<	30	60	100	Ω
Feedback capacitance at $f = 1 \text{ MHz}$ $-V_{GS} = 12 \text{ V}; V_{DS} = 0$	C <sub>rs</sub>	<	3,5	3,5	3,5	pF
Turn-off time $V_{DD} = 10 V; V_{GS} = 0$						
$I_D = 12 \text{ mA}; -V_{GSM} = 12 \text{ V}$	<sup>t</sup> off	<	20	· —	_	ns
$I_D = 6 \text{ mA}; -V_{GSM} = 7 \text{ V}$	toff	<	_	35	-	ns
$I_D = 3 \text{ mA}; -V_{GSM} = 5 \text{ V}$	t <sub>off</sub>	<	-	<b> </b>	50	ns

#### Dimensions in mm Marking code **MECHANICAL DATA** Fig. 1 SOT-23. PMBF4391 = M62 3,0 2,8 PMBF4392 = M63 В PMBF4393 = M64 1,9 0,150 0,090 0,95 = 0,2 M A B Α 2 0,1 max 10° max 1,4 1,2 2,5 max ₹ 10° → max 3 \_ 1,1 \_ max <del>Ф</del>|0,1(М) 30° 7296885 max

TOP VIEW

RATINGS						
Limiting values in accordance with the Absolute N	laximum Syste	m	(IEC 134)			
Drain-source voltage (See Fig. 4)			$^{\pm}$ V <sub>DS</sub>	max.	40	V
Drain-gate voltage (See Fig. 4)			$V_{DGO}$	max.	40	V
Gate-source voltage (See Fig. 4)	,		$-V_{GSO}$	max.	40	V
Gate current (d.c.)			IG	max.	50	mΑ
Total power dissipation up to T <sub>amb</sub> = 65 °C			$P_{tot}$	max.	250	mW
Storage temperature range			T <sub>stg</sub>	-65 to	+ 175	оС
Junction temperature			$T_{j}$	max.	175	оС
THERMAL CHARACTERISTICS						
$T_j = P(R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$						
Thermal resistance						
From junction to tab			R <sub>th j-t</sub>	=	60	K/W
From tab to soldering points			R <sub>th t-s</sub>	=	260	K/W
From soldering points to ambient *			R <sub>th s-a</sub>	=	120	K/W
CHARACTERISTICS						
T <sub>amb</sub> = 25 °C unless otherwise specified						
Gate-source voltage						
$I_G = 1 \text{ mA}; V_{DS} = 0$			$V_{GSon}$	<	1	V
Gate-source cut-off current					4	A
$V_{DS} = 0 \text{ V}; -V_{GS} = 20 \text{ V}$			-I <sub>GSS</sub>	<		nA ^
$V_{DS} = 0 \text{ V}; -V_{GS} = 20 \text{ V}; T_{amb} = 150 ^{o}\text{C}$			<sup>-I</sup> GSS	<	0,2	μΑ
		Pľ	MBF4391	PMBF4392	PMBF	4393
Drain current**		>	50	25	5	mΑ
$V_{DS} = 20 \text{ V}; V_{GS} = 0$	DSS	<	150	75	30	mΑ
Gate-source breakdown voltage						
$-I_G = 1 \mu A; V_{DS} = 0$	-V(BR)GSS	>	40	40	40	V
Gate-source cut-off voltage	. V	>	4	2	0,5	V
$I_D = 1 \text{ nA}; V_{DS} = 20 \text{ V}$	−V <sub>(P)GS</sub>	<	10	5		V
Drain-source voltage (on)						
$I_D = 12 \text{ mA}; V_{GS} = 0$	$V_{DSon}$	<	' 1	_	_	=
$I_D = 6 \text{ mA}; V_{GS} = 0$	V <sub>DSon</sub>	<	i	0,4	_	-
$I_D = 3 \text{ mA}; V_{GS} = 0$	$V_{DSon}$	<	-	_	0,4	V
Drain-source resistance (on) $I_D = 0; V_{GS} = 0; f = 1 \text{ kHz}$	r.	<	30	60	100	0
1D = 0, v GS = 0, 1 = 1 KHZ	<sup>r</sup> ds on		30 1	00 '	100	7.0

<sup>\*</sup> Mounted on a ceramic substrate of 7 mm x 5 mm x 0,7 mm. \*\* Measured under pulsed conditions;  $t_p$  = 100  $\mu$ s;  $\delta$  = 0,01.

		PM	BF4391	PMBF4392	PMBF4393
Drain cut-off current					
$-V_{GS} = 12 V_{1}$	IDSX	<	1		– nA
$-V_{GS} = 7 \text{ V } V_{DS} = 20 \text{ V}$	I <sub>DSX</sub>	<	-	1	– nA
$-V_{GS} = 7 \text{ V}$ $V_{DS} = 20 \text{ V}$ $-V_{GS} = 5 \text{ V}$	IDSX	<	_	_	1 nA
-V <sub>GS</sub> = 12 V <sub>)</sub>	IDSX	<	0,2	_	– μΑ
$-V_{GS} = 7 \text{ V}$ $V_{DS} = 20 \text{ V}; T_{amb} = 150 \text{ °C}$	DSX	<		0,2	— μΑ
$-V_{GS} = 5 V$	DSX	<		<b>–</b>	0,2 μΑ
y-parameters (common source) V <sub>DS</sub> = 20 V; V <sub>GS</sub> = 0; f = 1 MHz					
Input capacitance	Cis	<	14	14	14 pF
Feedback capacitance	C <sub>rs</sub>	<	3,5	3,5	3,5 pF
Switching times $V_{DD} = 10 \text{ V}; V_{GS} = 0$					
Conditions ID and $-V_{GSM}$	I <sub>D</sub>	=	12	6	3 mA
	$-V_{GSM}$	= [	12	7	5 V
Rise time	t <sub>r</sub>	<	5	5	5 ns
Turn on time	ton	<	15	15	15 ns
Fall time	tf	<	15	20	30 ns
Turn off time	toff	<	20	35	50 ns

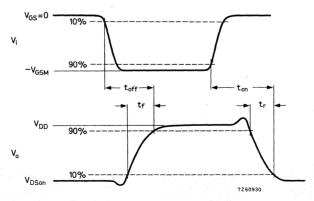


Fig. 2 Switching times waveforms.

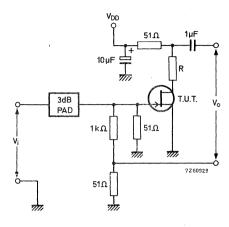


Fig. 3 Test circuit.

$$R = \frac{9.6}{I_D} - 51 \Omega$$

Pulse generator:

$$\begin{array}{lll} t_r & < & 0.5 \text{ ns} \\ t_f & < & 0.5 \text{ ns} \\ t_p & = & 100 \, \mu\text{s} \\ \delta & = & 0.01 \end{array}$$

Oscilloscope:

$$R_i = 50 \Omega$$

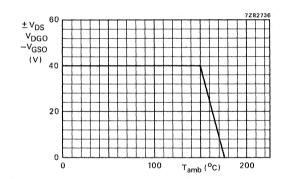


Fig. 4 Voltage derating curve.

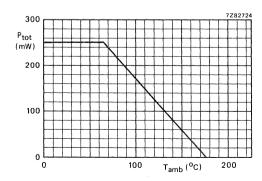


Fig. 5 Power derating curve.

# SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N silicon transistors, in a microminiature plastic envelope intended for switching and linear applications in thick and thin-film circuits.

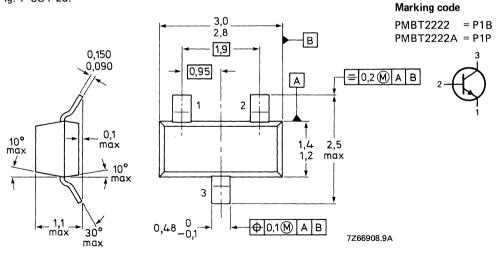
### **QUICK REFERENCE DATA**

			PMBT2222	PMBT2222	<u>2A</u>
Collector-base voltage (open emitter)	VCBO	max.	60	75	V
Collector-emitter voltage (open base)	VCEO	max.	30	40	V
Emitter-base voltage (open collector)	$V_{EBO}$	max.	5,0	6,0	V
Collector current (d.c.)	IC	max.	60	mA	
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	35	mW	
D.C. current gain $I_C = 150 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ $I_C = 500 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	hFE hFE	>	100 t 30	o 300 40	
Transition frequency at f = 100 MHz $I_C = 20 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	fT	>	250	300	MHz

### **MECHANICAL DATA**

Dimensions in mm





TOP VIEW

# PMBT2222 PMBT2222A

### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

		PMBT2222	PMBT2222	Α
Collector-base voltage (open emitter) see Fig. 4	VCBO	max. 60	75	٧
Collector-emitter voltage (open base) see Fig. 4	VCEO	max. 30	40	V
Emitter-base voltage (open collector) see Fig. 4	VEBO	max. 5,0	6,0	٧
Collector current (d.c.)	IC	max.	600	mA
Total power dissipation* up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	350	mW
Storage temperature range	T <sub>stg</sub>	-55	to 150	oC
Junction temperature	Tj	max.	150	oC
THERMAL RESISTANCE *				
From junction to ambient	R <sub>th j-a</sub>	= 1	350	K/W

### **CHARACTERISTICS**

T<sub>i</sub> = 25 °C unless otherwise specified

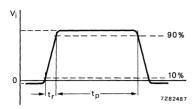
			PMBT2222	PMBT2222	2 <u>A</u>
Collector cut-off current					
$I_F = 0$ ; $V_{CB} = 50 \text{ V}$	ГСВО	<	0,01		μΑ
I <sub>E</sub> = 0; V <sub>CB</sub> = 60 V	ГСВО	<		0,01	μΑ
$I_E = 0$ ; $V_{CB} = 50 \text{ V}$ ; $T_i = 125 ^{\circ}\text{C}$	ГСВО	<	10		μΑ
$I_E = 0$ ; $V_{CB} = 60 \text{ V}$ ; $T_i = 125 ^{\circ}\text{C}$	ІСВО	<	일본 목과 모든	10	μΑ
$V_{EB} = 3 V; V_{CE} = 60 V$	ICEX	<		10	nΑ
Base current					
with reverse biased emitter junction					
$V_{EB} = 3 \text{ V}; V_{CE} = 60 \text{ V}$	IBEX	<	%.	20	nΑ
Emitter cut-off current					
$I_{C} = 0; V_{EB} = 3 V$	IEBO	<		10	nΑ
Saturation voltages**					
IC = 150 mA; IB = 15 mA	VCEsat	<	400	300	mV
	VBEsat	<	1300	_	mV
	V <sub>BEsat</sub>		i . –	0,6 to 1,2	V
IC = 500 mA; IB = 50 mA	VCEsat	<	1600	1000	mV
	VBEsat	<	2600	2000	mV
Breakdown voltages					
$I_C = 1.0 \text{ mA}; I_B = 0$	V(BR)CEO	>	30	40	V
$I_C = 100  \mu A; I_E = 0$	V(BR)CBO	>	60	75	V
$I_C = 0$ ; $I_E = 10 \mu\text{A}$	V(BR)EBO		5,0	6,0	V

<sup>\*</sup> Device mounted on a ceramic substrate of 15 mm x 15 mm x 0,7 mm.

<sup>\*\*</sup> Measured under pulsed conditions to avoid excessive dissipation;  $t_p \leqslant 300~\mu s$ ;  $\delta \leqslant 0.02$ .

			PMBT2222   P	МВТ2222	A
D.C. current gain					
I <sub>C</sub> = 0,1 mA; V <sub>CE</sub> = 10 V	hFE	>	35		
I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 10 V	hFE	>	50		
I <sub>C</sub> = 10 mA; V <sub>CE</sub> = 10 V	hFE	> > >	75		
$I_C = 10 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$ ; $T_{amb} = -55 ^{\circ}\text{C}$	hFE	>	35		
IC = 150 mA; VCE = 10 V	hFF		100 to 3	00	
IC = 150 mA; VCE = 1 V	hFE	>	50		
$I_C = 500 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	hFE	>	30	40	
Transition frequency at f = 100 MHz*					
I <sub>C</sub> = 20 mA; V <sub>CF</sub> = 20 V	fŢ	>	250	300	MHz
7 44 4 7 5 E					
Output capacitance at f = 1 MHz					
I <sub>E</sub> = 0; V <sub>CB</sub> = 10 V	Co	<	8,0		рF
	-0		0,0		þ.
Input capacitance at f = 1 MHz	<b>C</b>	<	30	25	
$I_C = 0; V_{EB} = 0,5 V$	Ci		30	25	
h-parameters (common emitter) at f = 1 kHz					
I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 10 V			00. 6		
input impedance	hie		2,0 to 8		k $\Omega$
reverse voltage transfer ratio	h <sub>re</sub>		< 8,0 x 10		
small signal current gain	hfe		50 to 3	T 1	
output admittance	hoe		5,0 to	35	μS
$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$					
input impedance	h <sub>ie</sub>		0,25 to 1,		k $\Omega$
reverse voltage transfer ratio	h <sub>re</sub>		< 4,0 x 10		
small signal current gain	hfe		75 to 3		- 2
output admittance	hoe		25 to 2	00	μS
Noise figure at Rs = 1 k $\Omega$					
$I_C = 100 \mu\text{A}$ ; $V_{CE} = 10 \text{V}$ ; $f = 1 \text{kHz}$	F		4,0		dB
Switching times (between 10% and 90% levels)					
Turn-on time switched to I <sub>C</sub> = 150 mA					
delay time	td	<	10		ns
rise time	tr		25		ns
	- ₹ <b>!</b> - 5	•			
Turn-off time switched from I <sub>C</sub> = 150 mA storage time	+	<	225		ne
fall time	t <sub>s</sub> t <sub>f</sub>	<	60		ns ns
	न		00		113

<sup>\*</sup>  $f_T$  is defined as the frequency at which  $h_{fe}$  extrapolates to unity.



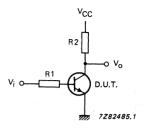


Fig. 2 Waveform and test circuit delay and rise time.

$$V_i = -0.5 \text{ to} + 9.9 \text{ V}; V_{CC} = 30 \text{ V}; R1 = 619 \Omega; R2 = 200 \Omega.$$

Pulse generator:

pulse duration rise time

duty factor

200 ns tp 2 ns

2 %

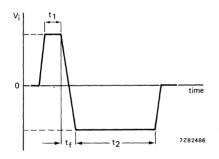
Oscilloscope:

rise time

input impedance input capacitance

100 k $\Omega$ 12 pF

5 ns



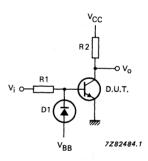


Fig. 3 Waveform and test circuit storage and fall time.

$$V_i = -13.8 \text{ to} + 16.2 \text{ V}; V_{CC} = 30 \text{ V}; -V_{BB} = 3 \text{ V}; R1 = 1 \text{ k}\Omega; R2 = 200 \Omega.$$

Pulse generator:

fall time

pulse time

5 ns tf 100 µs t1

500 μs t2

Oscilloscope:

rise time

input impedance

input capacitance

 $100~k\Omega$ 

< Ci 12 pF

5 ns

# SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P silicon transistors, in a microminiature plastic envelope, intended for medium power switching and general purpose amplifier applications in thick and thin-film circuits.

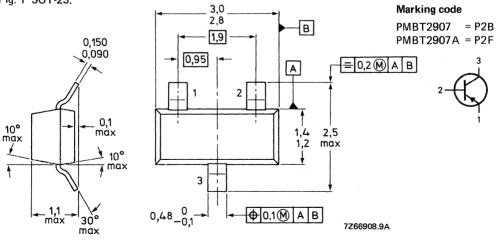
### QUICK REFERENCE DATA

			PMBT2907	PMBT2907	<u>'A</u>
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	60	60	V
Collector-emitter voltage (open base)	-VCEO	max.	40	60	V
Emitter-base voltage (open collector)	-VEBO	max.		5,0	V
Collector current (d.c.)	-IC	max.	60	0	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	35	0	mW
Junction temperature	Тj	max.	15	0	oC
D.C. current gain $-I_C = 500 \text{ mA}$ ; $-V_{CE} = 10 \text{ V}$	hFE	>	30	50	
Turn-off switching time $-I_{Con} = 150 \text{ mA}, -I_{Bon} = I_{Boff} = 15 \text{ mA}$	toff	<	10	0	ns
Transition frequency at f = 100 MHz -IC = 50 mA; -VCE = 20 V	fT	>	20	0	MHz

### **MECHANICAL DATA**

Dimensions in mm





TOP VIEW

# PMBT2907 PMBT2907A

**RATINGS** 

Limiting values in accordance with the Absolute Maximum System (IEC 134)

		PN	ивт2907	,	PMBT290	07A
Collector-base voltage (open emitter) see Figs 4 and 5	-V <sub>CBO</sub>	max.	60		60	V
Collector-emitter voltage (open base) see Figs 4 and 5	-V <sub>CEO</sub>	max.	40		60	
Emitter-base voltage (open collector) see Figs 4 and 5	-V <sub>EBO</sub>	max.		5,0		<b>V</b>
Collector current (d.c.)	−I <sub>C</sub>	max.		600		mA
Power dissipation up to Tamb = 25 °C	P <sub>tot</sub>	max.		350		mW
Storage temperature range	T <sub>stg</sub>		-65 to +	150		oC
Junction temperature	T <sub>j</sub>	max.		150		oC
THERMAL RESISTANCE *						
From junction to ambient in free air	R <sub>th j-a</sub>	- 1		350		K/W
CHARACTERISTICS						
T <sub>i</sub> = 25 °C unless otherwise specified						
		PΝ	/BT2907	,	PMBT290	)7A
Collector cut-off current $IE = 0$ ; $-V_{CB} = 50 \text{ V}$ $IE = 0$ ; $-V_{CB} = 50 \text{ V}$ ; $T_j = 125 \text{ °C}$ $-V_{FB} = 0.5 \text{ V}$ ; $-V_{CF} = 30 \text{ V}$	-ICBO -ICBO -ICEX	- < < <	20 20	50	10 10	
Base current with reverse biased emitter junctionVEB = 3 V;VCE = 30 V	-IBEX	<		50		nA
Saturation voltages**	BLX					
$-I_C = 150 \text{ mA}; -I_B = 15 \text{ mA}$	−VcEsat −VBEsat	< <		0,4 1,3		V V
$-I_C = 500 \text{ mA}; -I_B = 50 \text{ mA}$	−VCEsat −VBEsat	< <		1,6 2,6		V V
Collector-base breakdown voltage open emitter; $-I_C = 10 \mu A$ ; $I_E = 0$	-V(BR)CBO			60		V
Collector-emitter breakdown voltage open base;IC = 10 mA; IB = 0	-V(BR)CEO	>	40		60	V
Emitter-base breakdown voltage open collector; $-I_E = 10 \mu A$ ; $I_C = 0$	-V(BR)EBO			5,0		V

<sup>\*</sup> Device mounted on a ceramic substrate of 15 mm x 15 mm x 0,7 mm.

D.C. current gain  -I <sub>C</sub> = 0,1 mA; -V <sub>CE</sub> = 10 V  -I <sub>C</sub> = 1 mA; -V <sub>CE</sub> = 10 V	hFE hFF	> >	PMBT2907 35 50	PMBT2907, 75 100	<u>A</u>
$-I_C = 10 \text{ mA}; -V_{CE} = 10 \text{ V}$	hFE	>	75	100	
$-I_C = 150 \text{ mA}; -V_{CE} = 10 \text{ V}$ $-I_C = 500 \text{ mA}; -V_{CE} = 10 \text{ V}$	hFE hFE	>	100 t 30	o 300   50	
Transition frequency at f = 100 MHz $-I_C = 50 \text{ mA}$ ; $-V_{CE} = 20 \text{ V}$ ; $T_{amb} = 25 \text{ °C}$	f <sub>T</sub>	>	20	0	MHz
Output capacitance at f = 1 MHz IE = Ie = 0; -VCB = 10 V	Co	<	8	,0	pF
Input capacitance at $f = 1 \text{ MHz}$ IC = I <sub>C</sub> = 0; -VEB = 2 V	Ci	<	3	0	pF
Switching times (between 10% and 90% levels)					
Turn-on time when switched to $-I_C = 150 \text{ mA}; -I_B = 15 \text{ mA}; V_{CC} = 30 \text{ V}$					
delay time	t <sub>d</sub>	<		0	ns
rise time turn-on time (t <sub>d</sub> + t <sub>r</sub> )	t <sub>r</sub> ton	< <		.0 .5	ns ns
Turn-off time when switched from $-I_C = 150 \text{ mA}$ ; $-I_B = 15 \text{ mA}$ ; $V_{CC} = 6 \text{ V}$ to cut-off with $+I_{BM} = 15 \text{ mA}$ (see Fig. 3)	•				
storage time	t <sub>s</sub>	<	_	0	ns
fall time turn-off time (t <sub>S</sub> + t <sub>f</sub> )	t <sub>f</sub> toff	<	10	80 10	ns ns

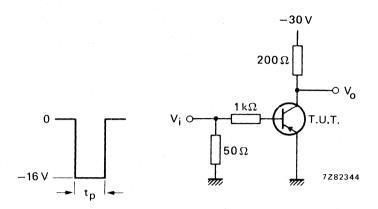


Fig. 2 Turn-on switching time test circuit.

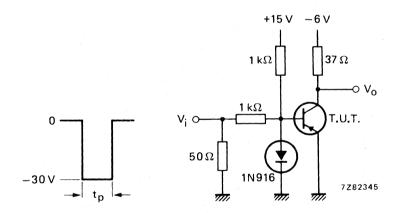


Fig. 3 Turn-off switching time test circuit.

frequency	f	=	150	Hz
pulse duration	tn	=	200	ns
rise time	tr	<	2	ns
output impedance	ż <sub>o</sub>	=	50	$\Omega$
rise time	t <sub>r</sub>	<	5	ns
input impedance	Żi	= '	10	$\Omega$ M
	pulse duration rise time output impedance rise time	$\begin{array}{ccc} \text{pulse duration} & & t_p \\ \text{rise time} & & t_r \\ \text{output impedance} & & Z_O \\ \text{rise time} & & t_r \end{array}$	$\begin{array}{llllllllllllllllllllllllllllllllllll$	$\begin{array}{llllllllllllllllllllllllllllllllllll$

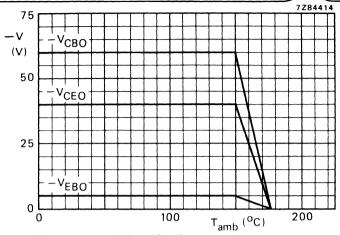
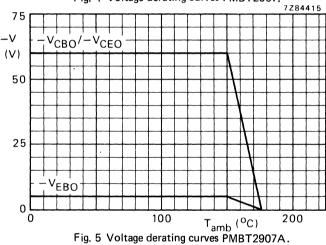


Fig. 4 Voltage derating curves PMBT2907.



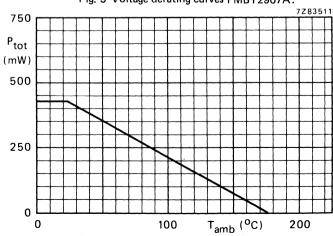


Fig. 6 Power derating curve PMBT2907/A.



### SILICON EPITAXIAL TRANSISTORS

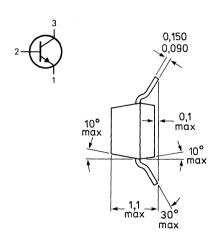
N-P-N transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

### QUICK REFERENCE DATA

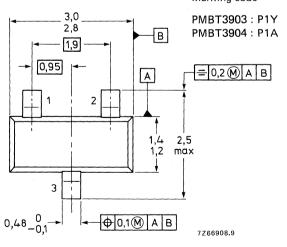
			PMBT3903	PME	T3904_
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	(	50	V
Collector-emitter voltage (open base)	VCEO	max.	,4	40	V
Emitter-base voltage (open collector)	$v_{EBO}$	max.		6	V
Collector current (d.c.)	IC	max.	20	00	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	30	00	mW
D.C. current gain IC = 10 mA; VCE = 1 V	hFE	> <	50 150	ı	100 300
Transition frequency at $f = 35 \text{ MHz}$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	fŢ	>	250	;	300 MHz

### **MECHANICAL DATA**

Fig. 1 SOT-23.



Dimensions in mm Marking code



TOP VIEW

See also Soldering recommendations.

# PMBT3903 PMBT3904

### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	60	· . V
Collector-emitter voltage (open base)	VCEO	max.	40	V
Emitter-base voltage (open collector)	VEBO	max.	6	. <b>V</b>
Collector current (d.c.)	IC	max.	200	mA
Total power dissipation* up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	300	mW
Storage temperature	T <sub>stq</sub>		-65 to +150	oC
Junction temperature	Tj	max.	150	oC
THERMAL RESISTANCE**				
$T_j = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ Thermal resistance	<b>D</b>		420	1Z /\AI
from junction to ambient*	R <sub>th j-a</sub>	=	430	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Collector-emitter breakdown voltage▲ I <sub>C</sub> = 1 mA; I <sub>B</sub> = 0	V(BR)CEO	min.	40	V
Collector-base breakdown voltage $I_C = 10 \mu A$ ; $I_E = 0$	V(BR)CBO	min.	60	V
Emitter-base breakdown voltage $I_E = 10 \mu A$ ; $I_C = 0$	V <sub>(BR)EBO</sub>	min.	6	V
Collector cut-off current VCE = 30 V; VEB = 3 V	ICEX	max.	50	nA
Output capacitance at f = 1 MHz IE = 0; VCB = 5 V	C <sub>c</sub>	max.	4	pF
Input capacitance at $f = 1 \text{ MHz}$ $I_C = 0$ ; $V_{BE} = 0.5 \text{ V}$	Ce	max.	8	pF
Base current with reverse biased emitter junction VEB = 3 V; VCE = 30 V	lnev	max.	50	nA
AER A A A CE - 20 A	BEX	illax.	30	11/2

<sup>\*</sup> Mounted on a ceramic substrate: area =  $10 \times 8 \text{ mm}^2$ ; thickness = 0.7 mm.

<sup>\*\*</sup> See Thermal characteristics.

<sup>■</sup> Pulse test conditions:  $t_p = 300 \mu s$ ; duty cycle  $\leq 2\%$ .

			PMBT3903	PMBT3904	1
Saturation voltages			0		V
I <sub>C</sub> = 10 mA; I <sub>B</sub> = 1 mA I <sub>C</sub> = 50 mA; I <sub>B</sub> = 5 mA	$V_{CEsat}$	max. max.		,2 ,3	V V
-	\/	min.	0,6	65	v V
IC = 10 mA; IB = 1 mA	VBEsat	max.	0,8	35	٧
$I_{C} = 50 \text{ mA}$ ; $I_{B} = 5 \text{ mA}$	$v_{BEsat}$	max.	0,9	95	V
D.C. current gain *					
$I_C = 0.1 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE	>	20	40	
I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 1 V	hFE	>	35	70	
I <sub>C</sub> = 10 mA; V <sub>CF</sub> = 1 V	hFF	> ,	50	100	
	-		150	300	
$I_C = 50 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE	>	30	60	
$I_C = 100 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE	>	15	30	
Transition frequency at f = 100 MHz					
$I_C = 10 \text{ mA}; V_{CE} = 20 \text{ V}$	fΤ	min.	250	300	MHz
Noise figure at R <sub>S</sub> = 1 k $\Omega$ I <sub>C</sub> = 100 $\mu$ A; V <sub>CE</sub> = 5 V				į.	
f = 10 Hz to 15,7 kHz	F	max.	6	5	dB
h-parameters (common emitter) IC = 1 mA; VCE = 10 V; f = 1 kHz					
Input impedance	hie		1 to 8	1 to 10	kΩ
Reverse voltage transfer ratio	h <sub>re</sub>		0,1 to 5	0,5 to 8	10 <sup>-4</sup>
Small-signal current gain	h <sub>fe</sub>	!	50 to 200	100 to 400	
Output admittance	hoe		1 to 40	1 to 40	μS
Switching times					
Turn-on time when $V_{CC} = 3 \text{ V}$ ; $V_{BE} = 0.5 \text{ V}$ $I_{C} = 10 \text{ mA}$ ; $I_{Bon} = 1 \text{ mA}$					
Delay time	t <sub>d</sub>	<	35	35	ns
Rise time	tr	<	35	35	ns
Turn-off time when $V_{CC} = 3 \text{ V}$ ; $I_C = 10 \text{ mA}$ $I_{Bon} = I_{Boff} = 1 \text{ mA}$					
Storage time	ts	<	175	200	ns
Fall time	t <sub>f</sub>	<	50	50	ns

<sup>\*</sup> Pulse test conditions:  $t_p$  = 300  $\mu$ s; duty cycle  $\leq$  2%.

1		

# SILICON EPITAXIAL TRANSISTOR

P-N-P transistor in a microminiature (SMD) plastic envelope intended for surface mounted applications. The PMBT3906 is primarily intended for use in telephony and professional communication equipment.

### QUICK REFERENCE DATA

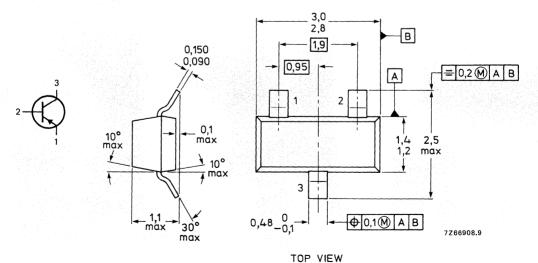
Collector-base voltage (open emitter)		-VCBO	max.	40 V
Collector-emitter voltage (open base)		-VCEO	max.	40 V
Emitter-base voltage (open collector)		-VEBO	max.	5 V
Collector current (d.c.)		-IC	max.	200 mA
Total power dissipation up to $T_{amb} = 2$	25 oC	$P_{tot}$	max.	300 mW
D.C. current gain $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 1 \text{ V}$		hFE	100	to 300
Transition frequency at f = 100 MHz $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 20 \text{ V}$		fŢ	າin.	250 MHz

#### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm

Marking code PMBT3906 : P2A



See also Soldering recommendations.

# **PMBT3906**

### **RATINGS**

RATINGS				
Limiting values in accordance with the Absolute Maximum Sy	stem (IEC 134)			
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40	٧
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	40	٧
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	V
Collector current (d.c.)	-IC	max.	200	mΑ
Total power dissipation* up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	300	mW
Storage temperature	T <sub>stg</sub>	-55 to	+150	oC
THERMAL CHARACTERISTICS**				
$T_j = P(R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$				
Thermal resistance				
from junction to ambient	R <sub>th j-a</sub>		420	K/W
CHARACTERISTICS				
T <sub>amb</sub> = 25 °C unless otherwise specified				
Collector-emitter breakdown voltage▲ -I <sub>C</sub> = 1 mA; I <sub>B</sub> = 0	−V(BR)CEO	min.	40	V
Collector-base breakdown voltage $-I_C = 10 \mu A; I_E = 0$	−V(BR)CBO	min.	40	<b>V</b>
Emitter-base breakdown voltage $-1E = 10 \mu A$ ; $1C = 0$	−V(BR)EBO	min.	5	V
Collector cut-off current -V <sub>CE</sub> = 30 V; -V <sub>EB</sub> = 3 V	−lCE	max.	50	nA
Base current with reverse biased emitter junction	-IBEX	max.	50	nA
Output capacitance at $f = 100 \text{ kHz}$ $I_E = 0$ ; $-V_{CB} = 5 \text{ V}$	C <sub>c</sub>	max.	4,5	pF
Input capacitance at $f = 100 \text{ kHz}$ $I_C = 0$ ; $-V_{BE} = 0.5 \text{ V}$	Ce	max.	10	pF

<sup>\*</sup> Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

<sup>■</sup> Pulse test conditions:  $t_p = 300 \, \mu s$ ; duty cycle  $\leq 2\%$ .

Saturation voltages $-I_C = 10 \text{ mA}$ ; $-I_B = 1 \text{ mA}$	-V <sub>CEsat</sub>	max.	0,25	V
$-I_C = 50 \text{ mA}; -I_B = 5 \text{ mA}$	-V <sub>CEsat</sub>	max. min.	0,4 0,65	
$-I_C = 10 \text{ mA}; -I_B = 1 \text{ mA}$ $-I_C = 50 \text{ mA}; -I_B = 5 \text{ mA}$	-V <sub>BEsat</sub>	max.	0,85 0,95	
D.C. current gain	-V <sub>BBsat</sub>	IIIdX.	0,90	V
$-I_C = 0.1 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	min.	60	
$-I_C = 1 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	min.	80	
$-I_C = 10 \text{ mA; } -V_{CE} = 1 \text{ V}$	hFE	min. max.	100 300	
$-I_C = 50 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	min.	60	
$-I_C = 100 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	min.	30	
Transition frequency at $f = 100 \text{ MHz}$ $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 20 \text{ V}$	f <sub>T</sub>	min.	250	MHz
Noise figure at R <sub>S</sub> = 1 k $\Omega$ $-I_C$ = 100 $\mu$ A; $-V_{CE}$ = 5 V f = 10 Hz to 15,7 kHz	F	max.	4	dB
h-parameters (common emitter) $-I_C = 1 \text{ mA}; -V_{CE} = 10 \text{ V}; f = 1 \text{ kHz}$				
Input impedance	h <sub>ie</sub>	min. max.		$k\Omega$
Reverse voltage transfer ratio	h <sub>re</sub>	min. max.	.,-	10 <sup>-4</sup> 10 <sup>-4</sup>
Small signal current gain	h <sub>fe</sub>	min. max.	100 400	
Output admittance	h <sub>oe</sub>	min. max.	30 60	μS μS
Switching times  Turn-on time when $-V_{CC} = 3 \text{ V}$ ; $-V_{BE} = 0.5 \text{ V}$ $-I_{C} = 10 \text{ mA}$ ; $-I_{Bon} = 1 \text{ mA}$				
Delay time	t <sub>d</sub>	max.	35	ns
Rise time	t <sub>r</sub>	max.	35	ns
Turn-off time when $-V_{CC} = 3 \text{ V}$ ; $-I_C = 10 \text{ mA}$ $-I_{Bon} = -I_{Boff} = 1 \text{ mA}$				
Storage time	$t_S$	max.	225	ns
Fall time	tf	max.	75	ns



## SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature (SMD) plastic envelope intended for application in thick and thin film circuits (Surface Mounted Device).

They are primarily intended for use in telephony and professional communication equipment.

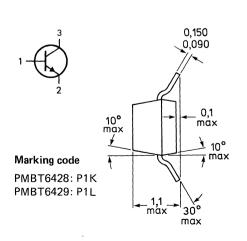
#### QUICK REFERENCE DATA

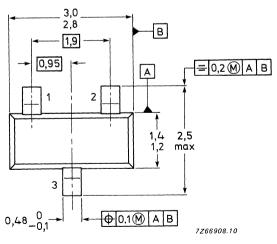
			PMBT6428	PMBT6429	
Collector-base voltage (open emitter)	Vсво	max.	60	55	V
Collector-emitter voltage (open base)	$v_{CEO}$	max.	50	45	V
Collector current (d.c.)	1C	max.	20	00	mΑ
Total power dissipation up to T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	35	50	mW
D.C. current gain $I_C = 0.1 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	hFE	min. max.	250 650	500 1250	
$I_C = 1 \text{ mA}; V_{CE} = 5 \text{ V}$	hFE	min.	250	500	
Transition frequency at $f = 100 \text{ MHz}$ IC = 1 mA; VCE = 5 V	fT	min. max.		00 00	MHz MHz
Input capacitance at f = 1 MHz IC = 0; VEB = 0,5 V	C <sub>e</sub>	max.	8	,0 pF	

#### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm





TOP VIEW

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBT6428	PMBT6429	)
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	60	55	٧
Collector-emitter voltage (open base)	VCEO	max.	50	45	V
Emitter-base voltage (open collector)	VEBO	max.	6,	0	V
Collector current (d.c.)	I <sub>C</sub>	max.	20	0	mΑ
Total power dissipation* up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>		35	0	mW
Storage temperature	$T_{stg}$		-55 to +15	0	oC
Junction temperature	т <sub>ј</sub>	max.	15	0	oC
THERMAL CHARACTERISTICS					
Thermal resistance from junction to ambient*	R <sub>th j-a</sub>	=	35	0	K/W
CHARACTERISTICS					
T <sub>amb</sub> = 25 °C unless otherwise specified					
			PMBT6428	PMBT6429	<del>)</del>
Collector-emitter breakdown voltage $I_C = 1 \text{ mA}$ ; $I_B = 0$	V(BR)CEO	min.	50	45	V
Collector-base breakdown voltage $I_C = 0,1 \text{ mA}$ ; $I_E = 0$	V(BR)CBO	min.	60	55	V
Collector cut-off current  VCE = 30 V  IF = 0; VCB = 30 V	ICEO ICBO	max. max.	10 1	0	nA nA
Emitter cut-off current I <sub>C</sub> = 0; V <sub>EB</sub> = 5 V	I <sub>EBO</sub>	max.	1	0	nΑ
Base-emitter On-voltage $I_C = 1 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	V <sub>BE(on)</sub>	min. max.	56 66		mV mV
e e					

<sup>\*</sup> Mounted on a ceramic substrate of 15 mm  $\times$  15 mm  $\times$  0,7 mm.

		Pi	MBT6428   PN	лвт6429	
Collector-emitter saturation voltage IC = 10 mA; IB = 0,5 mA	VCEsat	max.	0,2		V
IC = 100 mA; IB = 5 mA	VCEsat	max.	0,6		٧
D.C. current gain IC = 0,1 mA; VCF = 5 V	hee	min.	250	500	
I <sub>C</sub> = 0,1 mA; V <sub>CE</sub> = 5 V	hFE	min. max.	250 650	500 1250	
I <sub>C</sub> = 1 mA; V <sub>CE</sub> = 5 V	hFE	min.	250	500	
$I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	hFE	min.	250	500	
Transition frequency at f = 100 MHz IC = 1 mA; VCE = 5 V	f <del>T</del>	min. max.	100 700		MHz MHz
Output capacitance at f = 1 MHz IE = 0; VCB = 10 V	C <sub>c</sub>	max.	3,0		pF
Input capacitance at f = 1 MHz IC = 0; VEB = 0,5 V	C <sub>e</sub>	max.	8,0		pF

# SILICON EPITAXIAL TRANSISTORS

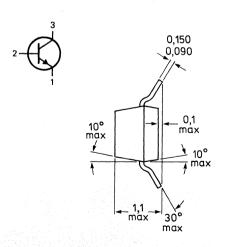
N-P-N transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

#### **QUICK REFERENCE DATA**

			PMBTA05	PMBTA06	
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	60	80	٧
Collector-emitter voltage (open base)	V <sub>CEO</sub>	max.	60	80	V
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.		4	٧
Collector current (d.c.)	Ic	max.	500	כ	mΑ
Total power dissipation up to Tamb =	25 °C P <sub>tot</sub>	max.	300	)	mW
D.C. current gain IC = 100 mA; VCE = 1 V	hFE	min.	50	)	
Transition frequency at $f = 100 \text{ MHz}$ IC = 10 mA; VCE = 2 V	f <sub>T</sub>	min.	100	0	MHz
Collector-emitter saturation voltage I <sub>C</sub> = 100; I <sub>B</sub> = 10 mA	VCEsa	ıt max.	0,2!	5	V

#### **MECHANICAL DATA**

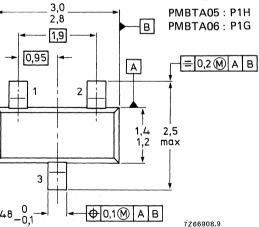
Fig. 1 SOT-23.



Dimensions in mm

Marking code

PMBTA05: P1H



TOP VIEW

## PMBTA05 PMBTA06

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

				PMBTA06		
Collector-base voltage	V <sub>CBO</sub>	max.	60		80	٧
Collector-emitter voltage (open base)	$v_{CEO}$	max.	60		80	٧
Emitter-base voltage (open collector)	V <sub>EBO</sub>	max.		4		V
Collector current (d.c.)	IC	max.	50	00		mΑ
Total power dissipation * up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	30	00		mW
Storage temperature	T <sub>stg</sub>		-65 to +15	50		oC
Junction temperature	Tj	max.	1	50		oC

### THERMAL CHARACTERISTICS \*\*

 $T_j = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

Thermal resistance

from junction to ambient

R <sub>th j-a</sub>	=	430	K/W
,			

#### **CHARACTERISTICS**

Tamb = 25 °C unless otherwise specified

			PMBTA05	PMBTA	06	
Collector-emitter breakdown voltage ▲ I <sub>C</sub> = 1 mA; I <sub>B</sub> = 0	V(BR)CEO	min.	60		80	V
Emitter-base breakdown voltage $I_C = 0$ ; $I_E = 100 \mu A$	V(BR)EBO	min.		4		V
Collector cut-off current V <sub>CE</sub> = 60 V; I <sub>B</sub> = 0	ICEO	max.	0	, <b>1</b> , ,		μΑ
Collector cut-off current  V <sub>CB</sub> = 60 V; I <sub>E</sub> = 0  V <sub>CB</sub> = 80 V; I <sub>E</sub> = 0	ICBO	max. max.		,1 ,1		μΑ μΑ
Saturation voltages IC = 100 mA; IB = 10 mA	VCEsat	max.	0,2	25		٧
Base-emitter on voltage IC = 100 mA; VCE = 1 V	VBE(on)	max.	1	,2		V
D.C. current gain $IC = 10 \text{ mA}$ ; $VCE = 1 \text{ V}$	hFE	min.	Ę	50		
$I_C = 100 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	min.		50		
Transition frequency at $f = 100 \text{ MHz}$ IC = 10 mA; VCE = 2 V	fT	min.	10	00		MHz

<sup>\*</sup> Mounted on a ceramic substrate: area =  $10 \times 8$  mm; thickness = 0.7 mm.

<sup>\*\*</sup> See Thermal characteristics.

<sup>■</sup> Pulse test conditions:  $t_p = 300 \, \mu s$ ; duty cycle  $\leq 2\%$ .

# N-P-N SMALL-SIGNAL DARLINGTON TRANSISTORS

N-P-N small-signal darlington transistors in a microminiature SMD envelope (SOT-23). Designed primarily for preamplifier input applications requiring high input impedance. P-N-P complement is the PMBTA63/64.

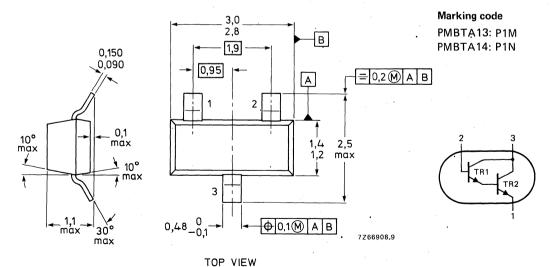
#### QUICK REFERENCE DATA

Collector-emitter voltage				
$V_{BE} = 0$		VCES	max.	30 V
Collector current (d.c.)		IC	max.	300 mA
Total power dissipation				
up to T <sub>amb</sub> = 25 °C		P <sub>tot</sub>	max.	300 mW
Junction temperature		Tj	max.	150 °C
D.C. current gain				
$I_C = 10 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	PMBTA13	hFE	min.	5000
	PMBTA14	hFE	min.	10 000
Transition frequency at f = 100 MHz				
$I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	•	fΤ	min.	125 MHz

#### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm



# PMBTA13 PMBTA14

RATINGS					
Limiting values in accordance with the	Absolute Maximum Syster	n (IEC 134)			
Collector-base voltage (open emitter)		$V_{CBO}$	max.	30	٧
Collector-emitter voltage VBE = 0		V <sub>CES</sub>	max.	30	V
Emitter-base voltage (open collector)		$V_{EBO}$	max.	10	٧
Collector current (d.c.)		I <sub>C</sub>	max.	300	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C*		P <sub>tot</sub>	max.	300	mW
Storage temperature		T <sub>stg</sub>	-65	to +150	oC
Junction temperature		Тј	max.	150	oC
THERMAL RESISTANCE					
From junction to ambient*		R <sub>th j-a</sub>		430	K/W
CHARACTERISTICS					
$T_j = 25$ °C unless otherwise specified					
Collector-emitter breakdown voltage $I_C = 100 \mu A$		V <sub>(BR)CES</sub>	min.	30	V
Emitter-base cut-off current VBE = 10 V		<sup>I</sup> EBO	max.	0,1	μΑ
Collector-base cut-off current VCB = 30 V		СВО	max.	0,1	μΑ
D.C. current gain					
$I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	PMBTA13 PMBTA14	hFE hFE	min. min.	5000 10 000	
$I_C = 100 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$	PMBTA13 PMBTA14	hFE hFE	min. min.	10 000 20 000	
Collector-emitter saturation voltage I <sub>C</sub> = 100 mA; I <sub>B</sub> = 0,1 mA		V <sub>CEsat</sub>	max.	1,5	V
Base-emitter ON-voltage $I_C = 100 \text{ mA}$ ; $V_{CE} = 5 \text{ V}$		V <sub>BE(on)</sub>	max.	2,0	V
Transition frequency at f = 100 MHz IC = 10 mA; VCE = 5 V		f <sub>T</sub>	min.	125	MHz

 $<sup>^*</sup>$  Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

## SILICON EPITAXIAL TRANSISTORS

N-P-N transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

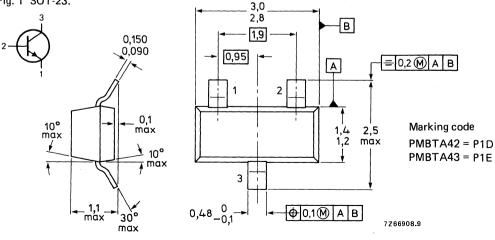
#### QUICK REFERENCE DATA

			PMBTA42		PMBTA43		
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	300		200	V	
Collector-emitter voltage (open base)	VCEO	max.	300		200	V	
Emitter-base voltage (open collector)	VEBO	max.		6		V	
Collector current (d.c.)	IC.	max.		500		mΑ	
Total power dissipation up to $T_{amb} = 35  {}^{\circ}C$	P <sub>tot</sub>	max.		310		mW	
Junction temperature	Tj	max.		150		oC	
D.C. current gain $I_C = 10 \text{ mA}$ ; $V_{CE} = 10 \text{ V}$	hFE	>		40			
Transition frequency at $f = 35$ MHz $I_C = 10$ mA; $V_{CE} = 20$ V	fΤ	>		50		MHz	
Feedback capacitance at f = 1 MHz I <sub>C</sub> = 0; V <sub>CE</sub> = 20 V	C <sub>re</sub>	<	3		4	pF	

#### **MECHANICAL DATA**

Dimensions in mm

Fig. 1 SOT-23.



TOP VIEW

## PMBTA42 PMBTA43

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBTA42		PMBTA4		
Collector-base voltage (open emitter)	$V_{CBO}$	max.	300		200	V	
Collector-emitter voltage (open base)	$V_{CEO}$	max.	300		200	٧	
Emitter-base voltage (open collector)	$V_{EBO}$	max.		6		V	
Collector current (d.c.)	IC	max.		500		mΑ	
Total power dissipation (note 1) up to T <sub>amb</sub> = 35 °C	P <sub>tot</sub>	max.		310		mW	
Storage temperature	T <sub>stg</sub>		-65 to +	150		oC	
Junction temperature	Tj	max.		150		oC	
THERMAL CHARACTERISTICS (note 2)							
T = D (D :							

 $T_j = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

Thermal resistance

from junction to ambient

 $R_{th j-a} = 430 K/W$ 

#### **CHARACTERISTICS**

Tamb = 25 °C unless otherwise specified

			PMBTA42	PMBTA4	3
Collector-emitter breakdown voltage (note 3) $I_C = 1 \text{ mA}$ ; $I_B = 0$	V(BR)CEO	>	300	200	_ V
Collector-base breakdown voltage $I_C = 100 \mu A$ ; $I_E = 0$	V(BR)CBO	>	300	200	V
Emitter-base breakdown voltage $IE = 100 \mu A; IC = 0$	V <sub>(BR)EBO</sub>	>	6	6	V
Collector cut-off current IE = 0; VCB = 200 V IE = 0; VCB = 160 V	ІСВО	< <	0,1	_ 0,1	μΑ μΑ
Emitter cut-off current IC = 0; VBE = 6 V IC = 0; VBE = 4 V	IEBO	< <	0,1	_ 0,1	μΑ μΑ
Feedback capacitance at f = 1 MHz IE = 0; VCB = 20 V	C <sub>re</sub>	<	3	4	pF

#### **Notes**

- 1. Mounted on a ceramic substrate: area = 2,5 cm<sup>2</sup>; thickness 0,7 mm.
- 2. See Thermal characteristics.
- 3. Pulse test conditions:  $t_p = 300 \ \mu s$ ;  $\delta = 0.02$ .

Saturation voltages $I_C = 20 \text{ mA}$ ; $I_B = 2 \text{ mA}$	VCEsat VBEsat	< <	0,5 0,9	V V
D.C. current gain				
$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$		>	25	
$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$	hFE	>	40	
$I_C = 30 \text{ mA}; V_{CE} = 10 \text{ V}$		>	40	
Transition frequency at f = 100 MHz				
$I_C = 10 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	fŢ	>	50	MHz

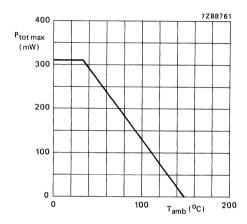


Fig. 2 Power derating curve.

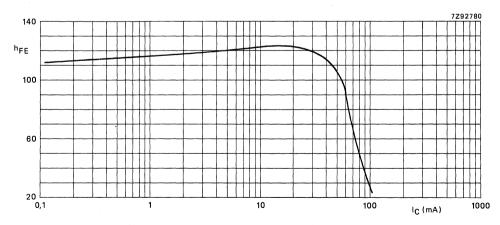
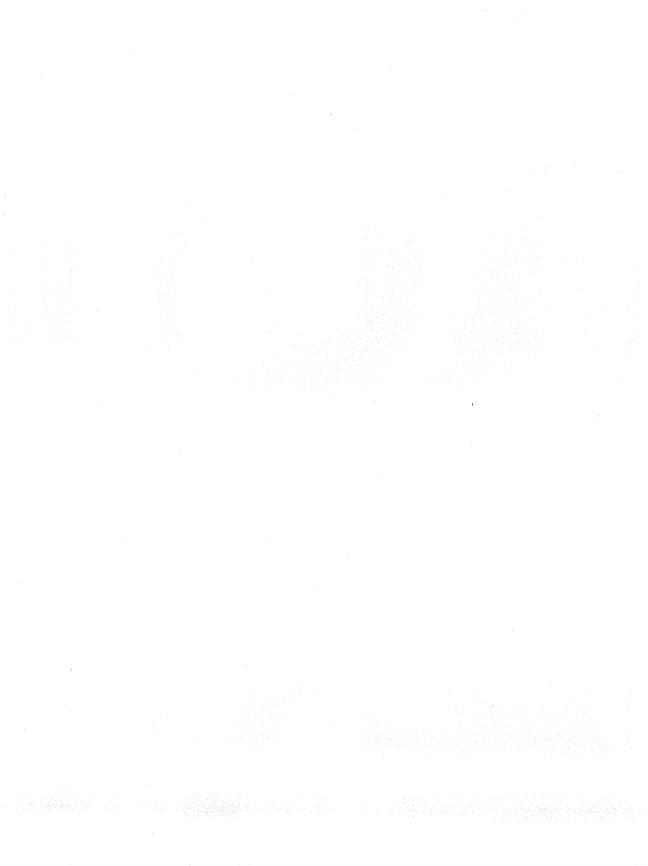


Fig. 3  $T_j = 25$  °C;  $V_{CE} = 20$  V; typical values.



## SILICON EPITAXIAL TRANSISTORS

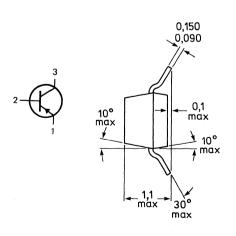
P-N-P transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

#### **QUICK REFERENCE DATA**

			PMBTA55	PMBTA56	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	60	80	٧
Collector-emitter voltage (open base)	-VCEO	max.	60	80	٧
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		4	V
Collector current (d.c.)	-IC	max.	50	0	mA
Total power dissipation up to $T_{amb} = 25$ oC	$P_{tot}$	max.	30	00	mW
D.C. current gain $-I_C = 100$ mA; $-V_{CE} = 1$ V	hFE	min.	5	0	
Transition frequency at f = 100 MHz $-I_C = 100 \text{ mA}$ ; $-V_{CE} = 1 \text{ V}$	fT	min.	5	60	MHz
Collector-emitter saturation voltage $-I_C = 100$ ; $I_B = 10 \text{ mA}$	V <sub>CEsat</sub>	max.	0,2	25	V

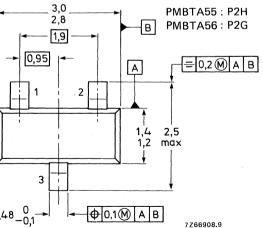
#### **MECHANICAL DATA**

Fig. 1 SOT-23.



Dimensions in mm





TOP VIEW

## PMBTA55 PMBTA56

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBTA55	PMBTA56	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	60	80	V
Collector-emitter voltage (open base)	-VCEO	max.	60	80	٧
Emitter-base voltage (open collector)	-V <sub>EBO</sub>	max.		4	٧
Collector current (d.c.)	-IC	max.	50	0	mΑ
Total power dissipation * up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	30	00	mW
Storage temperature	$T_{stg}$		-65 to +15	0	oC
Junction temperature	$T_{j}$	max.	. 15	0	oC

K/W

430

PMBTA55 | PMBTA56

#### THERMAL CHARACTERISTICS\*\*

 $T_j = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$ 

Thermal resistance

from junction to ambient Rth j-a

#### **CHARACTERISTICS**

Tamb = 25 °C unless otherwise specified

Collector-emitter breakdown voltage▲ -I <sub>C</sub> = 1 mA; I <sub>B</sub> = 0	−V(BR)CEO	min.	60		80 V	
Emitter-base breakdown voltage $-I_C = 0$ ; $I_E = 100 \mu A$	-V(BR)EBO	min.		4	, V	
Collector cut-off current -VCE = 60 V; IB = 0	-ICEO	max.	0,	,1	μΑ	4
Collector cut-off current -V <sub>CB</sub> = 60 V; I <sub>E</sub> = 0 -V <sub>CB</sub> = 80 V; I <sub>E</sub> = 0	-ICBO	max. max.	0,		μ <i>β</i>	
Saturation voltages $-I_C = 100 \text{ mA}$ ; $-I_B = 10 \text{ mA}$	-V <sub>CEsat</sub>	max.	0,2	<b>?</b> 5	٧	
Base-emitter on voltage $-I_C = 100 \text{ mA}; -V_{CE} = 1 \text{ V}$	-V <sub>BE</sub> (on)	max.	1	,2	٧	
D.C. current gain -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 1 V -I <sub>C</sub> = 100 mA; -V <sub>CE</sub> = 1 V	hFE hFE	min. min.	_	50 50		
Transition frequency at $f = 100 \text{ MHz}$ $-I_C = 100 \text{ mA}; -V_{CE} = 1 \text{ V}$	fT	min.	Ę	50	M	Hz

<sup>\*</sup> Mounted on a ceramic substrate: area = 10 x 8 mm; thickness = 0,7 mm.

<sup>\*\*</sup> See Thermal characteristics.

<sup>■</sup> Pulse test conditions:  $t_D = 300 \, \mu s$ ; duty cycle  $\leq 2\%$ .

## P-N-P SMALL-SIGNAL DARLINGTON TRANSISTORS

P-N-P small-signal darlington transistors in a microminiature SMD envelope (SOT-23). Designed primarily for preamplifier input applications requiring high input impedance. N-P-N complement is the PMBTA13/14.

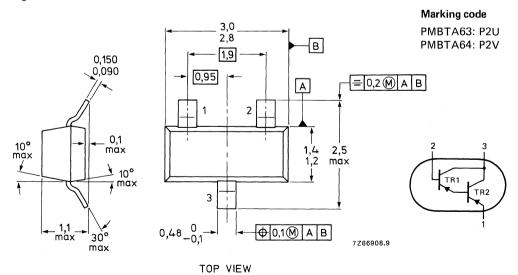
#### QUICK REFERENCE DATA

Collector-emitter voltage VBE = 0		-V <sub>CES</sub>	max.	30 V
Collector current (d.c.)		-IC	max.	500 mA
Total power dissipation up to T <sub>amb</sub> = 25 °C Junction temperature		P <sub>tot</sub> T <sub>i</sub>	max.	300 mW 150 °C
D.C. current gain $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 5 \text{ V}$	PMBTA63 PMBTA64	hFE hFE	min. min.	5000 10 000
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 50 V		fŢ	min.	125 MHz

#### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm



See also Soldering recommendations.

uu a na baarantii

#### **RATINGS**

RATINGS					
Limiting values in accordance with the Absolute	Maximum Systen	n (IEC 134)			
Collector-base voltage (open emitter)		-V <sub>CBO</sub>	max.	30	V
Collector-emitter voltage					
$V_{BE} = 0$		-VCES	max.	30	V
Emitter-base voltage (open collector)		-VEBO	max.	10	V
Collector current (d.c.)		-IC	max.	500	mΑ
Total power dissipation up to $T_{amb} = 25  {}^{o}C^*$		P <sub>tot</sub>	max.	500	mW
Storage temperature		$T_{stg}$	-65 t	o +150	oC
Junction temperature		Тj	max.	150	oC
THERMAL RESISTANCE					
From junction to ambient*		R <sub>th j-a</sub>		430	K/W
CHARACTERISTICS					
T <sub>j</sub> = 25 °C unless otherwise specified					
Collector-emitter breakdown voltage $-I_C = 100 \mu A$		-V(BR)CES	min.	30	V
Emitter-base cut-off current -VBE = 10 V		-1ЕВО	max.	0,1	μΑ
Collector-base cut-off current -VCB = 30 V		-Ісво	max.	0,1	μΑ
D.C. current gain					
$-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$	PMBTA63	hFE	min.	5000	
	PMBTA64	hFE	min.	10 000	
$-I_C = 100 \text{ mA}; -V_{CE} = 5 \text{ V}$	PMBTA63 PMBTA64	hFE hFE	min. min.	10 000 20 000	
Collector-emitter saturation voltage $-I_C = 100 \text{ mA}$ ; $-I_B = 0.1 \text{ mA}$		-V <sub>CEsat</sub>	max.	1,5	V
Base-emitter ON-voltage $-I_C = 100 \text{ mA}; -V_{CE} = 5 \text{ V}$		-VBE(on)	max.	2,0	V
Transition frequency at f = 100 MHz $-I_C$ = 10 mA; $-V_{CE}$ = 50 V; $T_{amb}$ = 25 °C		f <sub>T</sub>	min.	125	MHz

<sup>\*</sup> Mounted on a ceramic substrate of 8 mm x 10 mm x 0,7 mm.

## SILICON EPITAXIAL TRANSISTORS

P-N-P transistors in a microminiature (SMD) plastic envelope intended for surface mounted applications. They are primarily intended for use in telephony and professional communication equipment.

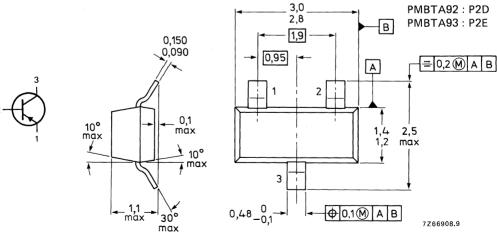
#### QUICK REFERENCE DATA

			PMBTA92	PMBTA93	3
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	300	200	V
Collector-emitter voltage (open base)	-VCEO	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5	V
Collector current (d.c.)	-IC	max.	50	00	mA
Total power dissipation up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	30	00	mW
D.C. current gain $-I_C = 10 \text{ mA; } -V_{CE} = 10 \text{ V}$	hFE	min.	· · · · · · · · · · · · · · · · · · ·	40	
Transition frequency at $f = 100 \text{ MHz}$ $-I_C = 10 \text{ mA; } -V_{CE} = 20 \text{ V}$	fT	min.	į	50	MHz
Collector-base capacitance at $f = 1 \text{ MHz}$ $I_E = 0$ ; $-V_{CB} = 20 \text{ V}$	C <sub>cb</sub>	max.	6	8	pF

#### **MECHANICAL DATA**

Fig. 1 SOT-23.

Dimensions in mm Marking code



TOP VIEW

## PMBTA92 PMBTA93

#### **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

			PMBTA92	PMBTA93	
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	300	200	V
Collector-emitter voltage (open base)	-VCEO	max.	300	200	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.		5	V
Collector current (d.c.)	-IC	max.	50	0	mΑ
Total power dissipation * up to T <sub>amb</sub> = 25 °C	P <sub>tot</sub>	max.	30	0	mW
Storage temperature	T <sub>stg</sub>		-65 to +15	0	oC
Junction temperature	Tj	max.	15	0	oC

#### **THERMAL CHARACTERISTICS \*\***

$$T_j = P (R_{th j-t} + R_{th t-s} + R_{th s-a}) + T_{amb}$$
  
Thermal resistance

from junction to ambient\*

 $R_{th j-a} =$ 

430

K/W

#### **CHARACTERISTICS**

Tamb = 25 °C unless otherwise specified

			PMBTA92	РМВТА93	
Collector-emitter breakdown voltage $-I_C = 1 \text{ mA}$ ; $I_B = 0$	-V <sub>(BR)</sub> CEO	min.	300	200	V
Collector-base breakdown voltage $-I_C = 100 \mu A$ ; $I_E = 0$	-V(BR)CBO	min.	300	200	V
Collector cut-off current $-V_{CB} = 200 \text{ V}; I_E = 0$ $-V_{CB} = 160 \text{ V}; I_E = 0$	-1СВО	max. max.	0,25 —	_ 0,25	μΑ μΑ
Emitter-base breakdown voltage $-I_E = 100 \mu A$ ; $I_C = 0$	−V(BR)EBO	min.		 5	V
Emitter cut-off current IC = 0; -VBE = 3 V	-IEBO	max.	0,	1	μΑ
Collector-base capacitance at f = 1 MHz;					
$IE = 0; -V_{CB} = 20 V$	C <sub>cb</sub>	max.	6	8	рF
Saturation voltages $-I_C = 20 \text{ mA}$ ; $-I_B = 2 \text{ mA}$ $-I_C = 20 \text{ mA}$ ; $-I_B = 2 \text{ mA}$	−VCEsat −VBEsat	max. max.	0, 0,		V V
D.C. current gain ▲  -I <sub>C</sub> = 1 mA; -V <sub>CE</sub> = 10 V  -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 10 V  -I <sub>C</sub> = 30 mA; -V <sub>CE</sub> = 10 V	hFE hFE hFE	min. min. min.		5 0 5	

<sup>\*</sup> Mounted on a ceramic substrate: area =  $10 \times 8$  mm; thickness = 0.7 mm.

<sup>\*\*</sup> See Thermal characteristics.

## VOLTAGE REGULATOR DIODES FOR SURFACE MOUNTING

Silicon planar diodes in a SOD-80 envelope intended for use as low-power voltage stabilizers or voltage references.

The series consists of 43 types with nominal working voltages ranging from 3,0 V to 75 V.

The SM diode is a leadless diode in a hermetically sealed glass SOD-80 envelope with tin-plated metal discs at each end. It is suitable for "automatic placement" and as such can withstand immersion soldering.

The diodes are delivered on "super 8" tape.

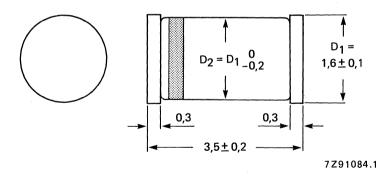
#### QUICK REFERENCE DATA

Working voltage range	$v_{Z}$	nom.	3,0 to 75 V
Working voltage tolerance			± 5 %
Total power dissipation	P <sub>tot</sub>	max.	500 mW
Non-repetitive peak reverse power dissipation $T_i = 55$ °C; $t_p = 8.3$ ms, square wave	P <sub>ZSM</sub>	max.	10 W
Junction temperature	T <sub>j</sub>	_	65 to + 200 °C

#### **MECHANICAL DATA**

Fig. 1 SOD-80.

Dimensions in mm



Cathode indicated by yellow band.

# PMLL5225B to PMLL5267B

## **RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Average forward current (averaged over any 20 ms period)	<sup>I</sup> F(AV)	max.	250	mA
Repetitive peak forward current	IFRM	max.	250	mA
Total power dissipation if flanges are kept at T <sub>flange</sub> = 75 °C	P <sub>tot</sub>	max.	500	mW
Derating factor			4	mW/K
Non-repetitive peak reverse power dissipation $T_j = 55$ °C; $t_p = 8.3$ ms, square wave	PZSM	max.	10	w
Storage temperature	$T_{stg}$	-65 to	+ 200	оС
Junction temperature	Τį	-65 to	+ 200	oC

#### **CHARACTERISTICS**

T<sub>amb</sub> = 25 °C unless otherwise stated

Forward voltage I<sub>F</sub> = 200 mA

type number	working voltage VZ (V) at Iztest (note 1) nom.	test current IZtest (mA)	max. Zener impedance Z <sub>Z</sub> T (Ω) at I <sub>Ztest</sub> (note 2)	differential resistance rdiff (Ω) at I <sub>ZK</sub> = 0,25 mA (note 2) max.	reverse current $^{\rm I}{\rm R}$ $^{\rm (}\mu{\rm A})$ at $^{\rm V}{\rm R}$ max.	test voltage VR (V)	temp. coeff. Sz (%/K) (note 3) max.
PMLL5225B PMLL5226B PMLL5227B PMLL5228B PMLL5229B	3,0 3,3 3,6 3,9 4,3	20 20 20 20 20 20	29 28 24 23 22	1600 1600 1700 1900 2000	50 25 15 10 5	1,0 1,0 1,0 1,0 1,0	-0,075 -0,070 -0,065 -0,060 ± 0,055
PMLL5230B PMLL5231B PMLL5232B PMLL5233B PMLL5234B	4,7 5,1 5,6 6,0 6,2	20 20 20 20 20 20	19 17 11 7 7	1900 1600 1600 1600 1000	5 5 5 5	2,0 2,0 3,0 3,5 4,0	± 0,030 ± 0,030 + 0,038 + 0,038 + 0,045
PMLL5235B PMLL5236B PMLL5237B PMLL5238B PMLL5239B	6,8 7,5 8,2 8,7 9,1	20 20 20 20 20 20	5 6 8 8 10	750 500 500 600 600	3 3 3 3	5,0 6,0 6,5 6,5 7,0	+ 0,050 + 0,058 + 0,062 + 0,065 + 0,068

 $V_{\mathsf{F}}$ 

1,1 V

max.

rentpilit in a

type number	working voltage VZ (V) at I <sub>ztest</sub> (note 1) nom.	test current <sup>I</sup> Ztest (mA)	$\begin{array}{c} \text{max. Zener} \\ \text{impedance} \\ \text{$^{Z}ZT$} \\ (\Omega) \\ \text{at $ _{Z\text{test}}$} \\ \text{(note 2)} \end{array}$	differential resistance $^{r}$ diff $(\Omega)$ at $^{l}$ ZK = 0,25 mA (note 2) max.	reverse current $^{\rm I}{\rm R}$ $_{(\mu{\rm A})}$ at $^{\rm V}{\rm R}$ max.	test voltage VR (V)	temp. coeff. Sz (%/K) ←  (note 3) max.
PMLL5240B PMLL5241B PMLL5242B PMLL5243B PMLL5244B	10 11 12 13 14	20 20 20 9,5 9,0	17 22 30 13 15	600 600 600 600 600	3 2 1 0,5 0,1	8,0 8,4 9,1 9,9	+ 0,075 + 0,076 + 0,077 + 0,079 + 0,082
PMLL5245B	15	8,5	16	600	0,1	11	+ 0,082
PMLL5246B	16	7,8	17	600	0,1	12	+ 0,083
PMLL5247B	17	7,4	19	600	0,1	13	+ 0,084
PMLL5248B	18	7,0	21	600	0,1	14	+ 0,085
PMLL5249B	19	6,6	23	600	0,1	14	+ 0,086
PMLL5250B	20	6,2	25	600	0,1	15	+ 0,086
PMLL5251B	22	5,6	29	600	0,1	17	+ 0,087
PMLL5252B	24	5,2	33	600	0,1	18	+ 0,088
PMLL5253B	25	5,0	35	600	0,1	19	+ 0,089
PMLL5254B	27	4,6	41	600	0,1	21	+ 0,090
PMLL5255B	28	4,5	44	600	0,1	21	+ 0,091
PMLL5256B	30	4,2	49	600	0,1	23	+ 0,091
PMLL5257B	33	3,8	58	700	0,1	25	+ 0,092
PMLL5258B	36	3,4	70	700	0,1	27	+ 0,093
PMLL5259B	39	3,2	80	800	0,1	30	+ 0,094
PMLL5260B	43	3,0	93	900	0,1	33	+ 0,095
PMLL5261B	47	2,7	105	1000	0,1	36	+ 0,095
PMLL5262B	51	2,5	125	1100	0,1	39	+ 0,096
PMLL5263B	56	2,2	150	1300	0,1	43	+ 0,096
PMLL5264B	60	2,1	170	1400	0,1	46	+ 0,097
PMLL5265B	62	2,0	185	1400	0,1	47	+ 0,097
PMLL5266B	68	1,8	230	1600	0,1	52	+ 0,097
PMLL5267B	75	1,7	270	1700	0,1	56	+ 0,098

#### **Notes**

- 1. Vz is measured with device at thermal equilibrium while held in clips in still air at 25 °C.
- 2. I(ac rms) = 10% of IZtest resp. IZK, 60 Hz superimposed.
- 3. For types PMLL5225B to PMLL5242B the current  $I_Z$  = 7,5 mA; for PMLL5243B and higher  $I_Z$  =  $I_{Ztest}$ . Testpoints at  $T_1$  = 25 °C,  $T_2$  = 125 °C.

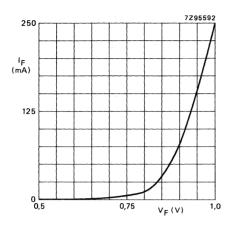


Fig. 2  $T_{amb} = 25$  °C; typical values.

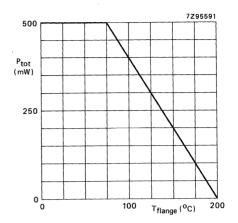


Fig. 3 Total power dissipation versus flange temperature.

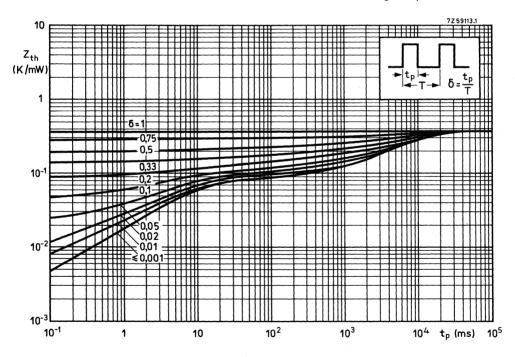


Fig. 4 Thermal impedance versus pulse duration.

# SILICON PLANAR EPITAXIAL TRANSISTOR

 $\mbox{N-P-N}$  transistor in a SOT-89 envelope primarily intended for high-speed, saturated switching applications for industrial service.

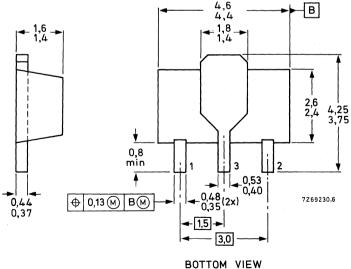
#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	60 V
Collector-emitter voltage (open base)	VCEO	max.	40 V
Collector current (d.c.)	IC	max.	200 mA
Total power dissipation at T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	1,0 W
Junction temperature	Τį	max.	150 °C
D.C. current gain $I_C = 10 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	> <	100 300
Transistion frequency at $f = 100 \text{ MHz}$ $I_C = 10 \text{ mA}$ ; $V_{CE} = 20 \text{ V}$	f <sub>T</sub>	>	300 MHz
Storage time $I_{Con} = 10 \text{ mA}$ ; $I_{Bon} = -I_{Boff} = 1 \text{ mA}$	t <sub>S</sub>	<	200 ns

#### **MECHANICAL DATA**

Fig. 1 SOT-89.

# Marking code P1A



Dimensions in mm

RATINGS				
Limiting values in accordance with the Absolute Maximum System (IEC	C 134)			
Collector-base voltage (open emitter)	V <sub>CBO</sub>	max.	60	V
Collector-emitter voltage (open base)	VCEO	max.	40	V
Emitter-base voltage (open collector)	VFBO	max.	6	V
Collector current (d.c.)	IC	max.	200	mA
Total power dissipation at T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	1,0	W
Storage temperature	T <sub>stg</sub>	55 to +	150	οС
Junction temperature	Tj	max.	150	oC
THERMAL RESISTANCE				
From junction to ambient in free air	R <sub>th j-a</sub>	= "	125	K/W
CHARACTERISTICS				
T <sub>j</sub> = 25 °C unless otherwise specified				
Currents at reverse biased emitter junction $V_{CE} = 30 \text{ V}$ ; $-V_{BE} = 3 \text{ V}$	I <sub>CEX</sub>	< ,		nA nA
Saturation voltages $I_C = 10 \text{ mA}$ ; $I_B = 1 \text{ mA}$	VCEsat VBEsat	< 650 to	200 850	-
I <sub>C</sub> = 50 mA; I <sub>B</sub> = 5 mA	VCEsat VBEsat	< <	300 950	
D.C. current gain $I_C = 0.1 \text{ mA}; V_{CE} = 1 \text{ V}$ $I_C = 1 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE hFE	>	40 70 100	
$I_C = 10 \text{ mA}$ ; $V_{CE} = 1 \text{ V}$	hFE	<	300	
$I_C = 50 \text{ mA}; V_{CE} = 1 \text{ V}$ $I_C = 100 \text{ mA}; V_{CE} = 1 \text{ V}$	hFE hFE	> 1	60 30	
Collector capacitance at 100 kHz $\leq$ f $\leq$ 1 MHz IE = Ie = 0; VCB = 5 V	Cc	<,	4,0	pF
Emitter capacitance at 100 kHz $\leq$ f $\leq$ 1 MHz I <sub>C</sub> = I <sub>C</sub> = 0; V <sub>EB</sub> = 0,5 V	Ce	<	8,0	pF
Transition frequency at f = 100 MHz  IC = 10 mA; VCE = 20 V; T <sub>amb</sub> = 25 °C	fŢ	>	300	MHz
Noise figure at R <sub>S</sub> = 1 k $\Omega$ I <sub>C</sub> = 100 $\mu$ A; V <sub>CE</sub> = 5 V f = 10 Hz to 15,7 kHz; T <sub>amb</sub> = 25 °C	F	<	5,0	dB

congresses.

<sup>\*</sup> Mounted on a ceramic substrate area = 2,5 cm<sup>2</sup>; thickness = 0,7 mm.

#### h-parameters (common emitter)

$$I_C = 1 \text{ mA}$$
;  $V_{CE} = 10 \text{ V}$ ;  $f = 1 \text{ kHz}$ ;  $T_{amb} = 25 \text{ °C}$ 

Input impedance

Reverse voltage transfer ratio

Small-signal current gain

Output admittance

#### Switching times

Turn-on time (see Figs 2 and 3) when switched from -VBEoff = 0,5 V to ICon = 10 mA; IBon = 1 mA

Delay time

Rise time

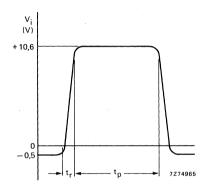


Fig. 2 Input waveform;  $t_r < 1$  ns;  $t_p = 300$  ns;  $\delta = 0.02$ .

Turn-off time (see Figs 4 and 5)

 $I_{Con} = 10 \text{ mA}$ ;  $I_{Bon} = -I_{Boff} = 1 \text{ mA}$ 

Storage time

Fall time

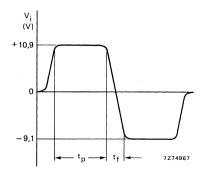


Fig. 4 Input waveform;  $t_f < 1$  ns;  $10 \mu s < t_p < 500 \mu s$ ;  $\delta = 0.02$ .

h<sub>ie</sub> 1 to 10 kΩ  
h<sub>re</sub> 0,5 to 8×10<sup>-4</sup>  
h<sub>fe</sub> 100 to 400  
h<sub>oe</sub> 1 to 40 
$$\mu$$
S

$$t_d$$
  $<$  35 ns  $t_r$   $<$  35 ns

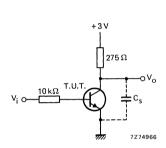


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors  $C_S < 4$  pF; scope impedance = 10 M $\Omega$ .

$$t_{
m s}$$
  $<$  200 ns  $t_{
m f}$   $<$  50 ns

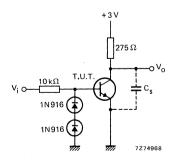


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors  $C_S < 4$  pF; scope impedance = 10 M $\Omega$ .



## SILICON PLANAR EPITAXIAL TRANSISTOR

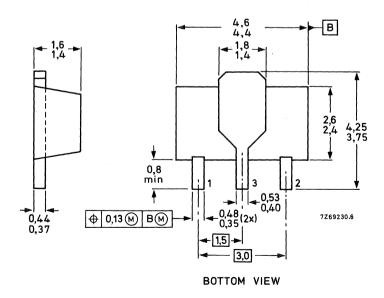
P-N-P transistor in a SOT-89 envelope primarily intended for high-speed, saturated switching applications for industrial service.

#### QUICK REFERENCE DATA

Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	40 V
Collector current (d.c.)	-IC	max.	200 mA
Total power dissipation at T <sub>amb</sub> = 25 °C	$P_{tot}$	max.	1,0 W
Junction temperature	Tj	max.	150 °C
D.C. current gain $-I_C = 10 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE	> <	100 300
Transition frequency at $f = 100 \text{ MHz}$ -I <sub>C</sub> = 10 mA; -V <sub>CE</sub> = 20 V	fT	>	250 MHz
Storage time -I <sub>Con</sub> = 10 mA; -I <sub>Bon</sub> = I <sub>Boff</sub> = 1 mA	t <sub>S</sub>	<	225 ns

#### **MECHANICAL DATA**

Fig. 1 SOT-89.



Dimensions in mm

## Marking code P2A



#### **RATINGS**

RATINGS			
Limiting values in accordance with the Absolute Maximum S	System (IEC 134)		
Collector-base voltage (open emitter)	-V <sub>CBO</sub>	max.	40 V
Collector-emitter voltage (open base)	-V <sub>CEO</sub>	max.	40 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5 V
Collector current (d.c.)	-IC	max.	200 mA
Total power dissipation at T <sub>amb</sub> = 25 °C*	P <sub>tot</sub>	max.	1,0 W
Storage temperature	$T_{stg}$	-55 to	o +150 °C
Junction temperature	Tj	max.	150 °C
THERMAL RESISTANCE			
From junction to ambient in free air*	R <sub>th j-a</sub>	= '	125 K/W
CHARACTERISTICS			
T <sub>j</sub> = 25 °C unless otherwise specified			
Currents at reverse biased emitter junction  -VCE = 30 V; + VBE = 3 V	-ICEX	<	50 nA
-vCF - 30 v'+ vBF - 2 v	+IBEX	<	50 nA
Saturation voltages $-I_C = 10 \text{ mA}$ ; $-I_B = 1 \text{ mA}$	−VCEsat −VBEsat	<sub>0.0</sub> / <sub>1</sub> < 650	250 mV to 850 mV
$-I_C = 50 \text{ mA}; -I_B = 5 \text{ mA}$	−VCEsat −VBEsat	< <	400 mV 950 mV
D.C. current gain -I <sub>C</sub> = 0,1 mA; -V <sub>CE</sub> = 1 V -I <sub>C</sub> = 1 mA; -V <sub>CE</sub> = 1 V	hFE hFE	>	60 80 100
$-I_C = 10 \text{ mA}; -V_{CE} = 1 \text{ V}$	pEE	<	300
$-I_C = 50 \text{ mA}; -V_{CE} = 1 \text{ V}$ $-I_C = 100 \text{ mA}; -V_{CE} = 1 \text{ V}$	hFE hFE	> 1	60 30
Collector capacitance at 100 kHz $\leq$ f $\leq$ 1 MHz IE = Ie = 0; -VCB = 5 V	C <sub>c</sub>	< 1	4,5 pF
Emitter capacitance at 100 kHz $\leq$ f $\leq$ 1 MHz IC = I <sub>C</sub> = 0; -V <sub>EB</sub> = 0,5 V	C <sub>e</sub>	<	10 pF
Transition frequency at f = 100 MHz $-I_C = 10 \text{ mA}$ ; $-V_{CE} = 20 \text{ V}$ ; $T_{amb} = 25 \text{ °C}$	fT	>	250 MHz
Noise figure at R <sub>S</sub> = 1 k $\Omega$ $-I_C$ = 100 $\mu$ A; $-V_{CE}$ = 5 V f = 10 Hz to 15,7 kHz; $T_{amb}$ = 25 °C	F	<	4,0 dB

<sup>\*</sup> Mounted on a ceramic substrate area = 2,5 cm<sup>2</sup>; thickness = 0,7 mm.

#### h-parameters (common emitter)

$$-I_C$$
 = 1 mA;  $-V_{CE}$  = 10 V; f = 1 kHz;  $T_{amb}$  = 25 °C Input impedance Reverse voltage transfer ratio Small-signal current gain Output admittance

#### Switching times

Turn-on time (see Figs 2 and 3) when switched from  $+V_{BEoff} = 0.5 V$  to  $-I_{Con} = 10 \text{ mA}$ ;  $-I_{Bon} = 1 \text{ mA}$  Delay time Rise time

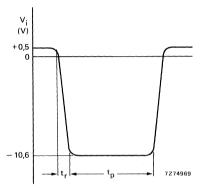


Fig. 2 Input waveform;  $t_r < 1$  ns;  $t_p = 300$  ns;  $\delta = 0.02$ .

Turn-off time (see Figs 4 and 5)  $-I_{Con} = 10 \text{ mA}; -I_{Bon} = I_{Boff} = 1 \text{ mA}$  Storage time Fall time

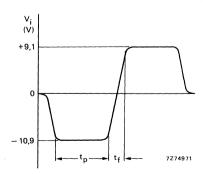
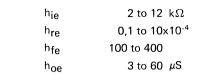


Fig. 4 Input waveform;  $t_f < 1$  ns;  $10 \mu s < t_p < 500 \mu s$ ;  $\delta = 0.02$ .





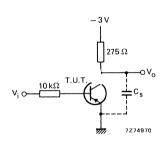


Fig. 3 Delay and rise time test circuit; total shunt capacitance of test jig and connectors  $C_S < 4~pF$ ; scope impedance = 10 M $\Omega$ .

$$t_{\mathrm{S}}$$
 < 225 ns  $t_{\mathrm{f}}$  < 75 ns

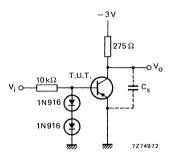
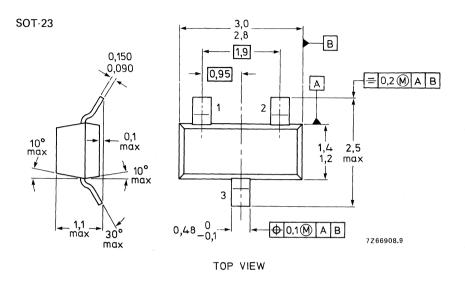


Fig. 5 Storage and fall time test circuit; total shunt capacitance of test jig and connectors  $C_S < 4~pF;$  scope impedance =  $10~M\Omega.$ 

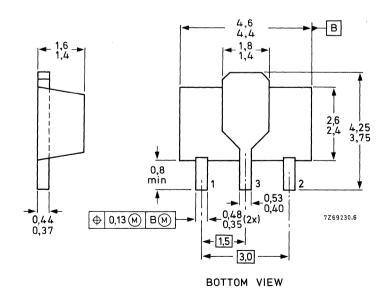
## **MECHANICAL DATA**

(European projection)

Dimensions in mm



**SOT-89** 

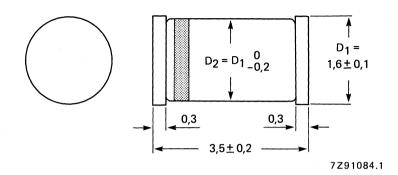


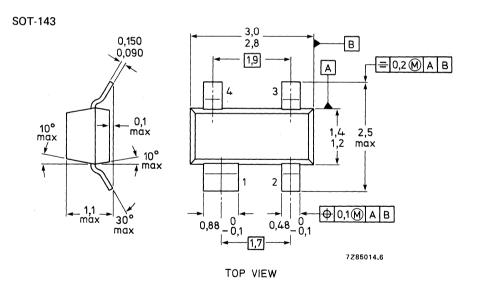
#### **MECHANICAL DATA**

(European projection)

Dimensions in mm

SOD-80





# INDEX OF TYPE NUMBERS

The inclusion of a type number in this publication does not necessarily imply its availability.

type no.	book	section	type no.	book	section	type no.	book	section
D1000	S1	an.	D1 C20	07.104	M /CD	BAV99	C7 /C1	Mm /CD
BA220		SD	BAS29	S7/S1	Mm/SD	1	S7/S1	Mm/SD
BA221	Ş1	SD	BAS31	S7/S1	Mm/SD	BAV 100	S7/S1	Mm/SD
BA223	S1	T	BAS32	S7/S1	Mm/SD	BAV101	S7/S1	Mm/SD
BA281	S1	SD	BAS35	S7/S1	Mm/SD	BAV 102	S7/S1	Mm/SD
BA314	S1	Vrg	BAS45	S1	SD	BAV103	S7/S1	Mm/SD
BA315	S1	Vrg	BAS56	S1/S7	SD/Mm	BAW56	S7/S1	Mm/SD
BA316	S1	SD	BAT17	S7/S1	Mm/T	BAW62	S1	SD
BA317	S1	SD	BAT18	S7/S1	Mm/T	BAX12	S1	SD
BA318	S1	SD	BAT54	S1/S7	SD/Mm	BAX14	S1	SD
BA423	S1	T	BAT74	S1/S7	SD/Mm	BAX18	S1	SD
BA480	S1	T	BAT81	S1	т	BAY80	S1	SD
BA481	S1	T	BAT82	S1	T	BB112	S1	T
BA482	S1	T	BAT83	S1	T	BB119	S1	T
BA483	S1	T	BAT85	S1	T	BB130	S1	T
BA484	S1	T	BAT86	S1	T	BB204B	S1	T
DA404	51	1	DAIGO	51	1	DDZO4D	ומ	1
BA682	S1/S7	T/Mm	BAV10	S1	SD	BB204G	S1	T
BA683	S1/S7	T/Mm	BAV18	S1	SD	BB212	S1	T
BAS11	S1	SD	BAV19	S1	SD	BB215	S7/S1	Mm/SD
BAS15	S1	SD	BAV20	S1	SD	BB219	S7/S1	Mm/SD
BAS16	S7/S1	Mm/SD	BAV21	s1	SD	BB405B	S1	T
BAS17	S7/S1	Mm/Vrq	BAV23	S7/S1	Mm/SD	BB417	S1	Т
BAS17	S7/S1	Mm/SD	BAV45	57/51 S1	ຕາແ/ລນ Sp	BB809	S1	T
BAS19	57/51 57/51		BAV45 BAV45A	S1	-	BB909A	S1	T
BAS20 BAS21		Mm/SD			Sp M= /CD	BB909A BB909B	S1	T
ł	S7/S1	Mm/SD	BAV70	S7/S1	Mm/SD			_
BAS28	S7/S1	Mm/SD	BAV74	S1	SD	BBY31	S7/S1	Mm/T

Mm = Microminiature semiconductors

for hybrid circuits

SD = Small-signal diodes

Sp = Special diodes

T = Tuner diodes

Vrg = Voltage regulator diodes

type no.	book	section	type no.	book	section	type no.	book	sectio
BBY39	· S1 ·	T	BC639	<b>.</b> S3	Sm	BCW69;R	<b>S</b> 7	Mm
BBY40	\$7/\$1	Mm/T	BC640	<b>S</b> 3	Sm	BCW70;R	<b>S</b> 7	Mm
BC 107	S3	Sm	BC807.	s7	Mm	BCW71;R	<b>\$</b> 7	Mm
BC108	S3	Sm	BC808	s7	Mm	BCW72;R	s7	Mm
BC 109	S3	Sm	BC817	s7	Mm	BCW81;R	s7	Mm
BC140	S3	Sm	BC818	s7	Mm	BCW89;R	S7	Mm
BC 141	S3	Sm	BC846	<b>S</b> 7	Mm	BCX17;R	s7	Mm
BC146	S3	Sm	BC847	\$7 <sup>-</sup>	Mm	BCX18;R	s7	Mm
BC 160	<b>S</b> 3	Sm	BC848	s7	Mm	BCX19;R	<b>S</b> 7	Mm
BC161	S3	Sm	BC849	S7	Mm	BCX20;R	<b>s</b> 7	Mm
BC 177	<b>S</b> 3	Sm	BC850	s7	Mm	BCX51	<b>S</b> 7	Mm
BC178	S3	Smi	BC856	S7	Mm	BCX52	s7	Mm
BC 179	S3	Sm	BC857	s7	Mm	BCX53	s7	Mm
BC200	S3	Sm	BC858	S7	Mm	BCX54	s7	Mm
BC264A	S5	FET	BC859	S7	Mm ·	BCX55	S7	Mm
DCZO4A	33	rei	BC033	3/	rim	BCX33	5 <i>1</i>	MI
BC264B	<b>S</b> 5	FET	BC860	s7	Mm	BCX56	S7	Mm
BC264C	S5	FET	BC868	s7	Mm	BCX70*	s7	Mm
BC264D	S5	FET	BC869	s7	Mm	BCX71*	S7	Mm
BC327;A		Sm	BCF29;R	s7	Mm	BCY56	<b>S</b> 3	Sm
BC328	<b>S</b> 3	Sm	BCF30;R	s7	Mm	BCY57	S3	Sm
Danna .			nanaa n	0.7	14	DayEo	<b>a</b> 2	<b>G</b>
BC337;A	S3	Sm	BCF32;R	S7	Mm	BCY58	S3	Sm
BC338	S3	Sm	BCF33;R	S7	Mm	BCY59	S3	Sm
BC368	S3	Sm '	BCF70;R	S7	Mm	BCY70	S3	Sm
BC369	S3	Sm	BCF81;R	S7	Mm	BCY71	S3	Sm
BC375	.S3	Sm	BCV26	S7	Mm	BCY72	<b>S</b> 3	Sm
BC376	<b>S</b> 3	·Sm	BCV27	S7	Mm	BCY78	S3	Sm
BC546	S3	Sm ·	BCV61	S7	Mm	BCY79	s3	Sm
BC547	S3	Sm	BCV62	S7	Mm	BCY87	<b>S</b> 3	Sm
BC548	S3	Sm	BCV63	\$7	Mm	BCY88	S3	Sm
BC549	s3	Sm	BCV64	s7	Mm	BCY89	s3	Sm
22550		_					1 × 1	
BC550	S3	Sm	BCV65	s7	Mm	BD131	S4a	P
BC556	S3	Sm .	BCV71;R	S7	Mm	BD132	S4a	P
BC557	\$3	Sm	BCV72;R	S7	Mm	BD135	S4a	P
BC558	S3	Sm	BCW29;R	S7	Mm	BD136	S4a	P
BC559	<b>S</b> 3	Sm	BCW30;R	s7	Mm	BD137	S4a	P
BC560	s3	Sm	BCW31;R	<b>S</b> 7	Mm	BD138	S4a	p
BC635	S3	Sm	BCW31; R	S7	Mm	BD136	S4a S4a	P
BC636	S3	Sm	BCW32;R	S7	Mm	BD139	S4a S4a	P
BC637	53 53	Sm	BCW55;R	S7	Mm	BD140 BD201	54a S4a	P
BC638	S3	Sm	BCW61*	S7		1		
DC030	, Cu	?III	BCW01	31	Mm	BD202	S4a	P

<sup>=</sup> series

FET = Field-effect transistors

Mm. = Microminiature semiconductors

for hybrid circuits

P = Low-frequency power transistors

Sm = Small-signal transistors

T = Tuner diodes

type no.	book	section	type no.	book	section	type no.	book	section
BD203	S4a	P	BD331	S4a	P	BD827	S4a	P
BD204	S4a	P	BD332	S4a	P	BD828	S4a	P
BD226	S4a	P	BD333	S4a	P	BD829	S4a	P
BD227	S4a	P	BD334	S4a	P	BD830	S4a	P
BD228	S4a	P	BD335	S4a	P	BD839	S4a	P
BD229	S4a	P	BD336	S4a	P	BD840	S4a	P
BD230	S4a	P	BD337	S4a	P	BD841	S4a	P
BD231	5 <b>4</b> a	P	BD338	S4a	P	BD842	S4a	P
BD233	S4a	P	BD433	S4a	P	BD843	S4a	P
BD234	S4a	P	BD434	S4a	P	BD844	S4a	P
BD235	S4a	P	BD435	S4a	P	BD845	S4a	P
BD236	S4a	P	BD436	S4a	P	BD846	S4a	P
BD237	S4a	P	BD437	S4a	P	BD847	S4a	P
BD238	S4a	P	BD438	S4a	P	BD848	S4a	P
BD239	S4a	P	BD645	S4a	P	BD849	S4a	P
BD239A	S4a	P	BD646	S4a	P	BD850	S4a	P
BD239B	S4a	P	BD647	S4a	P	BD933	S4a	P
BD239C	S4a	P	BD648	S4a	P	BD934	S4a	P
BD240	S4a	P	BD649	S4a	P	BD935	S4a	P
BD240A	S4a	P	BD650	S4a	P	BD936	5 <b>4</b> a	P
BD240B	S4a	P	BD651	S4a	P	BD937	S4a	P
BD240C	S4a	P	BD652	54a	P	BD938	S4a	P
BD241	S4a	P	BD675	S4a	P	BD939	S4a	P
BD241A	S4a	P	BD676	S4a	P	BD940	S4a	P
BD241B	S4a	P	BD677	S4a	P	BD941	S4a	P
BD241C	S4a	P	BD678	S4a	P	BD942	S4a	P
BD242	S4a	P	BD679	S4a	P	BD943	S4a	P
BD242A	S4a	P	BD680	S4a	P	BD944	S4a	P
BD242B	S4a	P	BD681	S4a	P	BD945	S4a	P
BD242C	S4a	P	BD682	S4a	P	BD946	S4a	P
BD243	S4a	P	BD683	S4a	P	BD947	S4a	P
BD243A	S4a	P	BD684	S4a	P	BD948	S4a	P
BD243B	S4a	P	BD813	S4a	P	BD949	S4a	P
BD243C	S4a	P	BD814	S4a	P	BD950	S4a	P
BD244	S4a	P	BD815	S4a	P	BD951	S4a	P
BD244A	S4a	P	BD816	S4a	P	BD952	S4a	P
BD244B	S4a	P	BD817	S4a	P	BD953	S4a	P
BD244C	S4a	P	BD818	S4a	P	BD954	S4a	P
BD329	S4a	P	BD825	S4a	P	BD955	S4a	P
BD330	S4a	P	BD826	S4a	P	BD956	S4a	P

type no.	book	section	type no.	book	section	type no.	book	section
BDT20	S4a	P	BDT61B	S4a	P	BDV66A	S4a	р
BDT21	S4a	P	BDT61C	S4a	P	BDV66B	S4a	P
BDT29	S4a	P	BDT62	S4a	P	BDV66C	S4a	P
BDT29A	S4a	P	BDT62A	S4a	P	BDV66D	54a	P
BDT29B	S4a	P	BDT62B	S4a	P	BDV67A	S4a	P
DUIZJD	344	P	DDIGZD	540	•	DDV07A	Jaa	F
BDT29C	S4a	P	BDT62C	S4a	P	BDV67B	S4a	P
BDT30	S4a	P	BDT63	S4a	P	BDV67C	S4a	P
BDT30A	S4a	P	BDT63A	S4a	P	BDV67D	S4a	P
BDT30B	S4a	P	BDT63B	S4a	P	BDV91	S4a	P
BDT3OC	S4a	P	BDT63C	S4a	P	BDV92	S4a	P
BDT31	S4a	P	BDT64	S4a	P	BDV93	S4a	P
BDT31A	54a	P	BDT64A	S4a	P	BDV94	S4a	P
BDT31B	S4a	P	BDT64B	S4a	P	BDV95	S4a	P
BDT31C	S4a	P	BDT64C	S4a	P	BDV96	S4a	P
BDT37C	S4a	P	BDT65	S4a	P	BDW55	S4a	P
pp#201		_	DDMCE 1	C.4.	P	BDW56	S4a	P
BDT32A	S4a	P	BDT65A	S4a	P P	BDW57	54a S4a	P
BDT32B	S4a	P	BDT65B	54a	-			P
BDT32C	S4a	P	BDT65C	54a	P .	BDW58	54a	
BDT41	S4a	P	BDT81	54a	P	BDW59	S4a	P
BDT41A	5 <b>4</b> a	P	BDT82	S4a	P	BDW60	54a	P
BDT41B	S4a	P	BDT83	S4a	P	BDX35	S4a	P
BDT41C	S4a	P	BDT84	S4a	P	BDX36	S4a	P
BDT42	S4a	P	BDT85	S4a	P	BDX37	S4a	P
BDT42A	S4a	P	BDT86	S4a	P	BDX42	S4a	P
BDT42B	S4a	P	BDT87	S4a	P	BDX43	S4a	P
BDT42C	S4a	P	BDT88	S4a	P	BDX44	S4a	P
BDT51	S4a	P	BDT91	S4a	P	BDX45	S4a	P
BDT52	54a	P	BDT92	S4a	P	BDX46	S4a	P
BDT53	S4a	P	BDT93	S4a	P	BDX47	S4a	P
BDT54	54a 54a	P	BDT94	S4a	P	BDX62	S4a	P
		_	DD#05			DDWCOS	94-	
BDT55	S4a	P	BDT95	S4a	P	BDX62A	S4a	P
BDT56	S4a	P	BDT96	S4a	P	BDX62B	S4a	P
BDT57	S4a	P	BDV64	S4a	P	BDX62C	S4a	P
BDT58	S4a	P	BDV64A	S4a	P	BDX63	S4a	P
BDT60	S4a	P	BDV64B	S4a	P	BDX63A	S4a	P
BDT60A	S4a	P	BDV64C	S4a	P	BDX63B	S4a	P
BDT60B	S4a	P	BDV65	S4a	P	BDX63C	S4a	P
BDT6OC	S4a	P	BDV65A	S4a	P	BDX64	S4a	P
BDT61	S4a	P	BDV65B	S4a	P	BDX64A	S4a	P
BDT61A	S4a	P	BDV65C	S4a	P	BDX64B	S4a	P

P = Low-frequency power transistors

type no.	book	section	type no.	book	section	type no.	book	section
BDX64C	S4a	Р	BF247A	<b>S</b> 5	FET	BF579	<b>S</b> 7	Mm
BDX65	S4a	P	BF247B	S5	FET	BF583	S4b	HVP
BDX65A	S4a	P	BF247C	S5	FET	BF585	S4b	HVP
BDX65B	S4a	P	BF256A	S5	FET	BF587	S4b	HVP
BDX65C	S4a	P	BF256B	<b>S</b> 5	FET	BF591	S4b	HVP
DDVCC	S4a	P	PROFEG	as.	rem	DECOS	S4b	HVP
BDX66 BDX66A	S4a S4a	P	BF256C	S5 S3	FET Sm	BF593 BF620	54D S7	Mm
BDX66B	54a 54a	P P	BF324		Sm Sm	BF620	S7	rım Mm
			BF370	S3				
BDX66C	S4a	P	BF410A	S5	FET	BF622	S7	Mm
BDX67	S4a	P	BF410B	<b>S</b> 5	FET	BF623	s7	Mm
BDX67A	S4a	P	BF410C	<b>S</b> 5	FET	BF660;R	S7	Mm
BDX67B	S4a	P	BF410D	S5	FET	BF689K	S10	WBT
BDX67C	S4a	P	BF419	S4b	HVP	BF763	S10	WBT
BDX68	S4a	P	BF420	S3	Sm	BF767	s7	Mm
BDX68A	S4a	P	BF421	s3	Sm	BF819	S4b	HVP
BDX68B	S4a	P	BF422	s3	Sm	BF820	<b>S</b> 7	Mm
BDX68C	S4a	P	BF423	S3	Sm	BF821	S7	Mm
BDX69	S4a	P	BF450	S3	Sm	BF822	s7	Mm
BDX69A	S4a	P	BF451	S3	Sm	BF823	S7	Mm
BDX69B	S4a	P	BF457	54b	HVP	BF824	s7	Mm
pp://0.d	94-	P			4		_	
BDX69C	54a		BF458	S4b	HVP	BF840	s7	Mm
BDX77	54a	P	BF459	S4b	HVP	BF841	s7	Mm
BDX78	S4a	P	BF469	S4b	HVP	BF857	S4b	HVP
BDX91	54a	P	BF470	S4b	HVP	BF858	S4b	HVP
BDX92	S4a	<b>P</b> 2	BF471	S4b	HVP	BF859	S4b	HVP
BDX93	S4a	P	BF472	S4b	HVP	BF869	S4b	HVP
BDX94	S4a	P	BF483	s3	Sm	BF870	S4b	HVP
BDX95	S4a	P	BF485	<b>S</b> 3	Sm	BF871	S4b	HVP
BDX96	S4a	P	BF487	<b>S</b> 3	Sm	BF872	S4b	HVP
BDY90	S4a	P	BF494	<b>S</b> 3	Sm	BF926	<b>S</b> 3	Sm
BDY90A	S4a	P	BF495	<b>S</b> 3	Sm	BF936	s3	Sm
BDY91	S4a	P	BF496	S3	Sm	BF936	\$3 \$3	Sm Sm
BDY92	S4a	P	BF510	S7/S5	Mm/FET	BF960	S5	SM FET
BF 198	S3	Sm	BF511	S7/S5	Mm/FET			
BF199	S3	Sm	BF512	S7/S5	Mm/FET	BF964	\$5 \$5	FET
DF 133	55	Jiu	DE 3 12	51/55	rim/ LLI	BF966	ລວ	FET
BF240	<b>S</b> 3	Sm	BF513	S7/S5	Mm/FET	BF967	s3	Sm
BF241	<b>S</b> 3	Sm	BF536	s7	Mm	BF970	S3	Sm
BF245A	S5	FET	BF550;R	s7	Mm	BF979	S3	Sm
BF245B	<b>S</b> 5	FET	BF569	<b>s</b> 7	Mm	BF980	S5	FET
BF245C	S5	FET	BF570	s7	Mm	BF981	S5	FET

FET = Field-effect transistors

HVP = High-voltage power transistors

Mm = Microniature semiconductors

for hybrid circuits

P = Low-frequency power transistors

Sm = Small-signal transistors

WBT = Wideband transistors

type no.	book	section	type no.	book	section	type no.	book	section
BF982	S5	FET	BFQ32M	S10	WBT	BFR93R	<b>S</b> 7	Mm
BF989	S7/S5	Mm/FET	BFQ32S	S10	WBT	BFR94	S10	WBT
BF990	S7/S5	Mm/FET	BF033	S10	WBT	BFR95	S10	WBT
BF991	S7/S5	Mm/FET	BFQ33C	S10	WBT	BFR96	S10	WBT
BF992	S7/S5	Mm/FET	BFQ34	S10	WBT	BFR96S	S10	WBT
BF994	S7/S5	Mm/FET	BFQ34T	s10	WBT	BFR101A;	B S7/S5	Mm/FE
BF994S	s7	Mm/FET	BFQ42	S6	RFP	BFS17	S7/S10	Mm/WB
BF996	S7/S5	Mm/FET	BFQ43	S6	RFP	BFS17A	S10	WBT
BF996S	s7	Mm/FET	BFQ43S	S6	RFP	BFS17R	<b>S</b> 7	Mm
BF997	<b>S</b> 7	Mm/FET	BFQ51	S10	WBT	BFS18;R	s7	Mm
BFG23	S10	WBT	BFQ51C	S10	WBT	BFS19;R	<b>S</b> 7	Mm
BFG32	S10	WBT	BFQ52	S10	WBT	BFS20;R	S7	Mm
BFG34	S10	WBT	BFQ53	S10	WBT	BFS21	S5	FET
BFG51	S10	WBT	BFQ63	S10	WBT	BFS21A	S5	FET
BFG65	S10	WBT	BFQ65	S10	WBT	BFS22A	S6	RFP
BFG67	s7	Mm	BFQ66	S10	WBT	BFS23A	s6	RFP
BFG9OA	S10	WBT	BFQ67	S7/S10	Mm/WBT	BFT24	S10	WBT
BFG92A	S10	WBT	BFQ68	S10	WBT	BFT25	S7/S10	Mm/WB
BFG93A	S10	WBT	BFQ136	S10	WBT	BFT25R	S7	Mm
BFG96	S10	WBT	BFR29	S5	FET	BFT44	<b>S</b> 3	Sm
BFG195	S10	WBT	BFR30	S7/S5	Mm/FET	BFT45	s3	Sm
BFP9OA	S10	WBT	BFR31	S7/S5	Mm/FET	BFT46	S7/S5	Mm/FE
BFP91A	S10	WBT	BFR49	S10	WBT	BFT92	S7/S10	Mm/WB
BFP96	S10	WBT	BFR53	S7/S10	Mm/WBT	BFT92R	s7	Mm
BFQ10	<b>S</b> 5	FET	BFR53R	<b>S</b> 7	Mm	BFT93	S7/S10	Mm/WB
BFQ11	<b>S</b> 5	FET	BFR54	s3	Sm	BFT93R	s7	Mm
BFQ12	<b>S</b> 5	FET	BFR64	S10	WBT	BFW10	S5	FET
BFQ13	S5	FET	BFR65	S10	WBT	BFW11	S5	FET
BFQ14	<b>S</b> 5	FET	BFR84	S5	FET	BFW12	<b>S</b> 5	FET
BFQ15	\$5	FET	BFR90	S10	WBT	BFW13	S5	FET
BFQ16	S5	FET	BFR90A	<b>S10</b>	WBT	BFW16A	S10	WBT
BFQ17	S7/S10	Mm/WBT	BFR91	S10	WBT	BFW17A	S10	WBT
BFQ18A	s7/s10	Mm/WBT	BFR91A	S10	WBT	BFW30	S10	WBT
BFQ19	S7/S10	Mm/WBT	BFR92	S7/S10	Mm/WBT	BFW61	S5	FET
BFQ22S	S10	WBT	BFR92A	S7/S10	Mm/WBT	BFW92	S10	WBT
BFQ23	s10	WBT	BFR92AR	s7	Mm	BFW92A	S10	WBT
BFQ23C	S10	WBT	BFR92R	<b>S7</b>	Mm	BFW93	S10	WBT
BFQ24	S10	WBT	BFR93	S7/S10	Mm/WBT	BFX29	<b>S</b> 3	Sm
BFQ32	S10	WBT	BFR93A	S7/S10	Mm/WBT	BFX30	s3	Sm
BFQ32C	S10	WBT	BFR93AR	sr <sup>°</sup>	Mm	BFX34	s3	Sm

<sup>\* =</sup> series

Sm = Small-signal transistors

ThM = Thyristor modules

WBM = Wideband hybrid IC modules

WBT = Wideband transistors

FET = Field-effect transistors

Mm = Microminiature semiconductors

for hybrid circuits

RFP = R.F. power transistors and modules

RT = Tripler

type no.	book	section	type no.	book	section	. type no	. book	section
BFX84	<b>S</b> 3	Sm	BGY51	S10	WBM	BLF242	S6	RFP/FET
BFX85	<b>S</b> 3	Sm	BGY52	S10	WBM	BLF244	S6	RFP/FET
BFX86	<b>S</b> 3	Sm	BGY53	S10	WBM	BLF245	S6	RFP/FET
BFX87	53	Sm	BGY54	S10	WBM	BLT90/SL	S6	RFP
BFX88	<b>S</b> 3	Sm	BGY55	<b>S10</b>	WBM	BLT91/SL		RFP
BFX89	S10	WBT	BGY56	S10	WBM	BLT92/SL	<b>S</b> 6	RFP
BFY50	<b>S</b> 3	Sm	BGY57	S10	WBM	BLU20/12	S6 .	RFP
BFY51	s3	Sm	BGY58	S10	WBM	BLU30/12	S6	RFP
BFY52	s3	Sm	BGY58A	S10	WBM	BLU45/12	S6	RFP
BFY55	S3	Sm	BGY59	S10	WBM	BLU50	S6	RFP
BFY90	S10	WBT	BGY60	<b>S10</b>	WBM	BLU51	S6	RFP
BG2000	S1	RT	BGY61	S10	WBM	BLU52	S6	RFP
BG2097	S1	RT	BGY65	S10	WBM	BLU53	S6	RFP
BGD102	S10	WBM	BGY67	s10	WBM	BLU60/12	S6	RFP
BGD102E	S10	WBM	BGY67A	S10	WBM	BLU97	S6	RFP
BGD104	S10	WBM	BGY70	S10	WBM	BLU98 .	S6	RFP
BGD104E	S10	WBM	BGY71	S10	WBM	BLU99	S6	RFP
BGD502	S10	WBM	BGY74	S10	WBM	BLV10	S6	RFP
BGD504	S10	WBM	BGY75	S10	WBM	BLV11	S6	RFP
BGX885	S10	WBM	BGY78	S10	WBM	BLV20	S6	RFP
BGY22	s6	RFP	BGY84	s10	WBM	BLV21	s6	RFP
BGY22A	S6	RFP	BGY84A	S10	WBM	BLV25	S6	RFP
BGY23	S6	RFP	BGY85	S10	WBM	BLV30	S6	RFP
BGY23A	S6	RFP	BGY85A	S10	WBM	BLV30/12	S6	RFP
BGY32	S6	RFP	BGY86	S10	WBM	BLV31	S6	RFP
BGY33	S6	RFP	BGY87	s10	WBM	BLV32F	S6	RFP
BGY35	<b>S</b> 6	RFP	BGY88	S10	WBM	BLV33	S6	RFP
BGY36	s6	RFP	BGY90A	S6	RFP	BLV33F	S6	RFP
BGY40A	s6	RFP	BGY90B	S6	RFP	BLV36	S6	RFP
BGY40B	<b>S</b> 6	RFP	BGY93 *	S6	RFP	BLV45/12	S6	RFP
BGY41A	s6	RFP	BGY94 *	S6	RFP	BLV57	S6	RFP
BGY41B	<b>S</b> 6	RFP	BGY95A	S6	RFP	BLV59	S6	RFP
BGY43	s6	RFP	BGY95B	S6	RFP	BLV75/12	S6 .	RFP
BGY45A	S6	RFP	BGY96A	<b>S</b> 6	RFP	BLV80/28	S6	RFP
BGY45B	s6	RFP	BGY96B	S6	RFP	BLV90	s6	RFP
BGY46A	s6	RFP	BGY584A	S10	WBM	BLV90/SL		RFP
BGY46B	s6	RFP	BGY585A	S10	WBM	BLV91	S6	RFP
BGY47 *	S6	RFP	BGY586	S10	WBM	BLV91/SL	S6	RFP
BGY48 *	S6	RFP	BGY587	S10	WBM	BLV92	S6	RFP
BGY50	S10	WBM	BLF146	S6	RFP/FET	BLV93	S6	RFP

ThM = Thyristor modules WBM = Wideband hybrid IC modules

<sup>=</sup> series

FET = Field-effect transistors

RFP = R.F. power transistors and modules

#### **INDEX**

type no.	book	section	type no.	book	section	type no.	book	section
BLV94	<b>S</b> 6	RFP	BLX67	s6	RFP	BR100/03	S2b	Th
BLV95	S6	RFP	BLX68	S6	RFP	BR101	<b>S</b> 3	Sm
BLV97	S6	RFP	BLX69A	s6	RFP	BR210*	S2a	Th
BLV98	S6	RFP	BLX91A	S6	RFP	BR216*	S2a	Th
BLV99	S6	RFP	BLX91CB	S6	RFP	BR220*	S2a	Th
BLW29	<b>S</b> 6	RFP	BLX92A	s6	RFP	BRY39	<b>S</b> 3	Sm
BLW31	S6	RFP	BLX93A	s6	RFP	BRY56	S3	Sm
BLW32	S6	RFP	BLX94A	S6	RFP	BRY61	s7	Mm
BLW33	S6	RFP	BLX94C	S6	RFP	BRY62	S7	Mm
BLW34	S6	RFP	BLX95	<b>S</b> 6	RFP	BS107	<b>S</b> 5	FET
BLW5OF	<b>S</b> 6	RFP	BLX96	S6	RFP	BS170	S5	FET
BL <b>W</b> 60	S6	RFP	BLX97	<b>S</b> 6	RFP	BSD10	\$5	FET
BLW60C	S6	RFP	BLX98	S6	RFP	BSD12	<b>S</b> 5	FET
BLW76	S6	RFP	BLY87A	S6	RFP	BSD20	S5/7	FET
BL <b>W77</b>	<b>S</b> 6	RFP	BLY87C	s6	RFP	BSD22	S5/7	FET
BLW78	S6	RFP	BLY88A	s6	RFP	BSD212	S5	FET
BLW79	S6	RFP	BLY88C	S6	RFP	BSD213	<b>S</b> 5	FET
BLW80	S6	RFP	BLY89A	S6	RFP	BSD214	S5	FET
BLW81	S6	RFP	BLY89C	S6	RFP	BSD215	S5	FET
BLW83	S6	RFP	BLY90	S6	RFP	BSR12;R	s7	Mm
BLW84	<b>S</b> 6	RFP	BLY91A	<b>S6</b>	RFP	BSR13;R	s7	Mm
BLW85	S6	RFP	BLY91C	S6	RFP	BSR14;R	s7	Mm
BLW86	S6	RFP	BLY92A	S6	RFP	BSR15;R	S7	Mm
BLW87	S6	RFP	BLY92C	S6	RFP	BSR16;R	s7	Mm
BLW89	<b>S</b> 6	RFP	BLY93A	S6	RFP	BSR17;R	s7	Mm
BLW90	S6	RFP	BLY93C	<b>S</b> 6	RFP	BSR17A;R	s7	Mm
BLW91	S6	RFP	BLY94	S6	RFP	BSR18;R	s7	Mm
BLW95	s6	RFP	BPF24	S8b	PDT	BSR18A;R		Mm
BLW96	<b>S</b> 6	RFP	BPW22A	S8a/b	PDT	BSR19; A		Mm
BLW97	56	RFP	BPW50	S8a/b	PDT	BSR20; A		Mm
BLW98	<b>S</b> 6	RFP	BPW71	S8b	PDT	BSR30	<b>s</b> 7	Mm
BLW99	S6	RFP	BPX25	S8b	PDT	BSR31	<b>S</b> 7	Mm
BLX13	S6	RFP	BPX29	S8b	PDT	BSR32	<b>S</b> 7	Mm
BLX13C	S6	RFP	BPX40	S8b	PDT	BSR33	<b>S</b> 7	Mm
BLX14	S6	RFP	BPX41	S8b	PDT	BSR40	s7	Mm
BLX15	s6	RFP	BPX42	S8b	PDT	BSR41	s7	Mm
BLX39	S6	RFP	BPX61	58b	PDT	BSR42	s7	Mm
BLX65	S6	RFP	BPX61P	58b	PDT	BSR43	s7	Mm
BLX65E	S6	RFP	BPX71	S8b	PDT	BSR50	s3	Sm
		*** *	A	202	~ ~ -			

FET = Field-effect transistors

Mm = Microminiature semiconductors

for hybrid circuits

PDT = Photodiodes or transistors

RFP = R.F. power transistors and modules

Sm = Small-signal transistors

Th = Thyristors

type no.	book	section	type no.	book	section	type no.	book	section
BSR52	<b>s</b> 3	Sm	BST110	<b>S</b> 5	FET	BT169*	S2b	Th
BSR56	S7/S5	Mm/FET	BST120	S5/S7	FET/Mm	BTA140*	S2b	Tri
BSR57	S7/S5	Mm/FET	BST122	S5/S7	FET/Mm	BTR59*	S2b	Tri
BSR58	S7/S5	Mm/FET	BSV15	\$3	Sm	BTS59*	S2b	Tri
BSR60	s3	Sm	BSV16	<b>5</b> 3	Sm	BTV58*	S2b	Th
BSR61	s3	Sm	BSV17	<b>s</b> 3	Sm	BTV59*	S2b	Th
BSR62	s3	Sm	BSV52;R	<b>S</b> 7	Mm	BTV59D*	S2b	Th
BSS38	<b>5</b> 3	Sm	BSV64	s3	Sm	BTV60*	S2b	Th
BSS50	S3	Sm	BSV78	S5	FET	BTV60D*	S2b	Th
BSS51	<b>53</b>	Sm	BSV79	<b>S</b> 5	FET	BTV70*	S2b	Th
BSS52	<b>S</b> 3	Sm	BSV80	<b>S</b> 5	FET	BTV70D*	S2b	Th
BSS60	53	Sm	BSV81	S5	FET	BTW23*	S2b	Th
BSS61	<b>S</b> 3	Sm	BSW66A	53	Sm	BTW38*	S2b	Th
BSS62	S3	Sm	BSW67A	S3	Sm	BTW40*	S2b	Th
BSS63;R	<b>S</b> 7	Mm	BSW68A	<b>53</b>	Sm	BTW42*	S2b	Th
BSS64;R	s7	Mm	BSX19	<b>S</b> 3	Sm	BTW43*	S2b	Tri
BSS68	<b>S</b> 3	Sm	BSX20	S3	Sm	BTW45*	S2b	Th
BSS83	S5/7	FET/Mm	BSX45	S3	Sm	BTW58*	S2b	Th
BST15	s7, ,	Mm	BSX46	S3	Sm	BTW62*	S2b	Th
BST16	s7	Mm	BSX47	<b>S</b> 3	Sm	BTW62D*	S2b	Th
BST39	<b>s</b> 7	Mm	BSX59	<b>S</b> 3	Sm	BTW63*	s2b	Th
BST40	s7	Mm	BSX60	s3	Sm	BTY79*	S2b	Th
BST50	s7	Mm	BSX61	S3	Sm	BTY91*	S2b	Th
BST51	s7	Mm	BSY95A	. S3	Sm	BU426	S4b	SP
BST52	s7	Mm	BT136*	S2b	Tri	BU426A	S4b	SP
BST60	s7	Mm	BT136F*	S2b	Tri	BU433	s4b	SP
BST61	s7	Mm	BT137*	S2b	Tri	BU505	S4b	SP
BST62	s7	Mm	BT137F*	S2b	Tri	BU506	S4b	SP
BST70A	S5	FET	BT138*	S2b	Tri	BU506D	S4b	SP
BST72A	<b>S</b> 5	FET	BT138F*	S2b	Tri	BU508A	S4b	SP
BST74A	<b>S</b> 5	FET	BT139*	S2b	Tri	BU508D	S4b	SP
BST76A	S5	FET	BT139F*	S2b	Tri	BU705	S4b	SP
BST78	<b>S</b> 5	FET	BT145*	S2b	Tri	BU706	S4b	SP
BST80	\$5/\$7	FET/Mm	BT149*	S2b	Th	BU706D	S4b	SP
BST82	S5/S7	FET/Mm	BT150	S2b	Th	BU806	S4b	SP
BST84	S5/S7	FET/Mm	BT151*	S2b	Th	BU807	S4b	SP
BST86	S5/S7	FET/Mm	BT151F*	S2b	Th	BU808	S4b	SP
BST90	S5/5/	FET FET	BT 151F	52b	Th	BU824	S4b	SP
BST97	S5	FET		S2b S2b	Th	BU826	S4b	SP
	\$5 \$5	FET	BT153					
BST 100	ສວ	LEI	BT157*	S2b	Th	BUP22*	S4b	SP

<sup>\* =</sup> series

SP = Low-frequency switching power transistors

Th = Thyristors

Tri = Triacs

FET = Field-effect transistors

Mm = Microminiature semiconductors for hybrid circuits

Sm = Small-signal transistors

type no.	book	section	type no.	book	section	type no.	book	section
BUP23*	S4b	SP	BUZ 10A	S9	PM .	BUZ72A	<b>S</b> 9	PM
BUS11;A	S4b	SP	BUZ 1 1	S9	PM	BUZ73A	59	PM
BUS12:A	S4b	SP	BUZ 1 1A	S9	PM	BUZ74	59	PM
BUS 13; A	S4b	SP	BUZ 14	S9	PM	BUZ74A	59	PM
BUS14;A	S4b	SP	BUZ 15	59	PM	BUZ76	S9	PM
DOS14,A	מדע	J.	Don's			202,0	0,5	• • • •
BUS21*	S4b	SP	BUZ2O	<b>S</b> 9	PM	BUZ76A	<b>S</b> 9	PM
BUS22*	S4b	SP	BUZ21	S9	PM	BUZ80	<b>S</b> 9	PM ·
BUS23*	S4b	SP	BUZ23	S9	PM	BUZ8OA	S9	PM
BUT11;A	S4b	SP	BUZ24	S9	PM	BUZ83	<b>S</b> 9	PM
BUT11A	S4b	SP	BUZ25	S9	PM	BUZ83A	S9	PM
BUT11AF	S4b	SP	BUZ30	S9	PM	BUZ84	<b>S</b> 9	PM
BUV82	S4b	SP	BUZ31	s9	PM	BUZ84A	S9	PM
BUV83	S4b	SP	BUZ32	S9	PM	BY224*	S2a	R
BUV89	S4b	SP	BUZ33	S9	PM	BY225*	S2a	R
BUV90;A	S4b	SP	BUZ34	S9	PM	BY228	S1	R
BUW11;A	S4b	SP	BUZ35	S9	PM	BY229*	S2a	R
BUW12;A	S4b	SP	BUZ36	S9	PM	BY229F*	S2a	R
BUW13;A	S4b	SP	BUZ4O	S9	PM	BY249*	S2a	R
BUW84	S4b	SP	BUZ41A	59	PM	BY260*	S2a	R
BUW85	S4b	SP	BUZ42	S9	PM	BY261*	S2a	R
BUX46;A	S4b	SP	BUZ43	S9	PM	BY329*	S2a	R
BUX47;A	S4b	SP	BUZ44A	S9	PM	BY359*	S2a	R
BUX48; A	S4b	SP	BUZ45	59	PM	BY438	S1	R
BUX80	S4b	SP	BUZ45A	S9	PM	BY448	S1	R
BUX81	S4b	SP	BUZ45B	S9	PM	BY458	S1	R
BUX82	S4b	SP	BUZ45C	S9	P <b>M</b>	BY505	S1	R
BUX83	S4b	SP	BUZ46	S9	PM	BY509	S1	R
BUX84	S4b	SP	BUZ 5OA	S9	PM	BY527	S 1	R
BUX84F	S4b	SP	BUZ5OB	S9	PM	BY584	S1	R
BUX85	S4b	SP	BUZ53A	59	PM	BY588	S1	R
20			5023311	<b>5</b> ,5,5,5	• • •	51555		• 1
BUX85F	S4b	SP	BUZ54	<b>59</b>	P <b>M</b>	BY609	<b>S</b> 1	R
BUX86	S4b	SP	BUZ54A	59	PM	BY610	S1	R
BUX87	S4b	SP	BUZ60	59	PM	BY614	S1	R
BUX88	S4b	SP	BUZ60B	59	PM	BY619	S 1	R
BUX90	S4b	SP	BUZ63	S9	PM	BY620	S1	R
BUX98	S4b	SP	BUZ63B	S9	PM	BY627	s1	R
BUX98A	S4b	SP	BUZ 64	S9	PM	BY707	S1	R
BUX99	S4b	SP	BUZ71	S9	PM	BY708	S1	R
BUY89	S4b	SP	BUZ71A	S9	PM	BY709	S1	R
BUZ 10	S 9 S 9	PM	BUZ77A	S9	PM	BY710	S1	R
20210		£ 171	10012		EFI	D1710	۱ بر	.`

<sup>\* =</sup> series

PM = Power MOS transistors

R = Rectifier diodes

SP = Low-frequency switching power transistors

### **INDEX**

type no.	book	section	type no.	book	section	type no.	book	section
BY711	S1	R	BYV33*	S2a	R	BYX39*	S2a	R
BY712	S1	R	BYV33F*	S2a	R	BYX42*	S2a	R
BY713	S1	R	BYV34*	S2a	R	BYX46*	S2a	R
BY714	S1	R	BYV36 *	S1	R	BYX50*	S2a	R
BYD13 *	S1	R	BYV39*	S2a	R	BYX52*	S2a	R
BYD14 *	S1	R	BYV42*	S2a	R	BYX56*	S2a	R
BYD17 *	S1	R	BYV43*	S2a	R	BYX90G	S1	R
BYD33 *	S1	R	BYV43F*	S2a	R	BYX96*	S2a	R
BYD37 *	S1	R	BYV44*	S2a	R	BYX97*	S2a	R
BYD73 *	S1	R	BYV60*	S2a	R	BYX98*	S2a	R
BYD74 *	S1	R	BYV72*	S2a	R	BYX99*	S2a	R
BYD77 *	S1	R	BYV73*	S2a	R	BZD23	S1	Vrg
BYM26 *	S1	R	BYV74*	S2a	R	BZD27	S1	Vrg
BYM36 *	S1	R	BYV79*	S2a	R	BZTO3	S1	Vrg
BYM56 *	S1	R	BYV92*	S2a	R	BZV10	S1	Vrf
BYP21*	S2a	$\mathbf{R}$	BYV95A	S1	R	BZV11	S1	Vrf
BYP22*	S2a	R	BYV95B	S1	R	BZV12	S1	Vrf
BYP59*	S2a	R	BYV95C	S1	R	BZV13	S1	Vrf
BYQ28*	S2a	R	BYV96D	S1	R	BZV14	S1	Vrf
BYR29*	S2a	R	BYV96E	S1	R	BZV37	S1	Vrf
BYR29F*	S2a	R	BYW25*	S2a	R	BZV46	S1	Vrg
BYT28*	S2a	R	BYW29*	S2a	R	BZV49*	S1/S7	Vrg/Mm
BYT79*	S2a	R	BYW29F*	S2a	R	BZV55*	s7	Mm
BYV10	S1	R	BYW30*	S2a	R	BZV8O	S1	Vrf
BYV18*	S2a	R	BYW31*	S2a	R	BZV81	S1	Vrf
BYV19*	S2a	R	BYW54	S1	R	BZV85 *	S1	Vrg
BYV20*	S2a	R	BYW55	S1	R	BZWO3 *	S1	Vrg
BYV21*	S2a	R	BYW56	S1	R	BZW14	S1	Vrg
BYV22*	S2a	R	BYW92*	S2a	R	BZW86*	S2a	TS
BYV23*	S2a	R	BYW93*	S2a	R	BZX55 *	S1	Vrg
BYV24*	S2a	R	BYW95A	S1	R	BZX70*	S2a	Vrg
BYV26 *	S1/S2a	R	BYW95B	S1	R	BZX75 *	S1	Vrg
BYV27*	S1/S2a	R	BYW95C	S1	R	BZX79*	S1	Vrg
BYV28*	S1/S2a	R	BYW96D	S1	R	BZX84*	S7/S1	Mm/Vrg
BYV29*	S2a	R	BYW96E	S1	R	BZY91*	S2a	Vrg
BYV29F*	S2a	R	BYX 10G	S1	R	BZY93*	S2a	Vrg
BYV30*	S2a	R	BYX25*	S2a	R	CFX13	S11	M
BYV31*	S2a	R	BYX30*	S2a	R	CFX21	S11	M
BYV32*	S2a	R	BYX32*	S2a	R	CFX30	S11	M
BYV32F*	S2a	R	BYX38*	S2a	R	CFX31	S11	M

<sup>\* =</sup> series

LED = Light-emitting diodes
M = Microwave transistors

Mm = Microminiature semiconductors

for hybrid circuits

Ph = Photoconductive devices

PhC = Photocouplers

R = Rectifier diodes

TS = Transient suppressor diodes Vrf = Voltage reference diodes

Vrg = Voltage regulator diodes

tunono	hook	ion	tuno no	book	anation	tura na bos	ole assation
type no.	book	section	type no.	book	section	type no. boo	ok section
CFX32	S11	M	CQS54	S8a	LED	CQW6OA(L)S8a	LED
CFX33	S11	M	CQS82L	S8a	LED	CQW6OU(L)S8a	LED
CNG35	S8b	PhC	CQS82AL	S8a	LED	CQW61(L) S8a	LED
CNG36	S8b	PhC	CQS84L	S8a	LED	CQW62(L) S8a	LED
CNR36	S8b	PhC	CQS86L	S8a	LED	CQW89A S8a/1	
CMK50	200	FIIC	CODOUR	Jua	HLD	COMOJA JOA/	<i>.</i>
CNX21	S8b	PhC	CQS93	S8a	LED	CQW93 S8a	LED
CNX35	S8b	PhC	CQS93E	S8a	LED	CQW95 S8a	LED
CNX35U	S8b	PhC	CQS93L	S8a	LED	CQW97 S8a	LED
CNX36	S8b	PhC	CQS95	S8a	LED	CQX24(L) S8a	LED
CNX36U	S8b	PhC	CQS95E	S8a	LED	CQX51(L) S8a	LED
G177720	ant	nh a	GOGOET	CO.	TEN	GOVE 4 (T.). GO.	T DD
CNX38	S8b	PhC	CQS95L	58a 58a	LED	CQX54(L) S8a	LED
CNX38U	S8b	PhC	CQS97		LED	CQX54D S8a	LED
CNX39	S8b	PhC	CQS97E	S8a	LED	CQX64(L) S8a	LED
CNX39U	S8b	PhC	CQS97L	S8a	LED	CQX64D S8a	LED
CNX44	S8b	PhC	CQT10B	S8a	LED	CQX74(L) S8a	LED
CNX44A	S8b	PhC	CQT24	S8a	LED	CQX74D S8a	LED
CNX46	S8b	PhC	COT60	S8a	LED	CQY11B S8b	LED
CNX48	S8b	PhC	COT70	S8a	LED	COY11C S8b	LED
CNX48U	S8b	PhC	CQT8OL	S8a	LED	CQY24B(L)S8a	LED
CNX62	S8b	PhC	CQV70(L)		LED	CQY49B S8b	LED
~~~~	<b>~01</b>	D) 0	G011703 / T	٠. ٥٥٠	T. T.D.	g01140g g01	* ***
CNX72	S8b	PhC	CQV70A(L		LED	CQY49C S8b	LED
CNX82	S8b	PhC	CQV70U(L	-	LED	CQY50 S8b	LED
CNX83	S8b	PhC	CQV71A(L		LED	CQY52 S8b	LED
CNX91	S8b	PhC	CQV72(L)		LED	CQY53S S8b	LED
CNX92	S8b	PhC	COA80r	S8a	LED	CQY54A S8a	LED
CNY17-1	S8b	PhC	CQV8OAL	S8a	LED	CQY58A S8a/	b I
CNY17-2	S8b	PhC	CQV8OUL	S8a	LED	CQY89A S8a/	
CNY 17-3	S8b	PhC	CQV81L	S8a	LED	CQY94B(L)S8a	LED
CNY50	S8b	PhC	CQV82L	S8a	LED	CQY95B S8a	LED
CNY57	S8b	PhC	CQW1OA(L		LED	CQY96(L) S8	
00VF72	go.	Dh.a	G051405 / T	\ a o =	T. T.D.	gov073	
CNY57A	S8b	PhC	CQW10B(L		LED	CQY97A S8	
CNY57AU	S8b	PhC	CQW10U(L	-	LED	Fresnel- S8	b A
CNY57U	S8b	PhC	CQW11B(L		LED	lens	
CNY62	S8b	PhC	CQW12B(L		LED	H11A1 S8	
CNY63	S8b	PhC	CQW2OA	S8a	LED	H11A2 S8	b PhC
CQF24	S8b	Ph	CQW21	S8a	LED	H11A3 S8	b PhC
CQL10A	S8b	Ph	CQW22	S8a	LED	H11A4 S8	
CQL13A	S8b	Ph	CQW24(L)		LED	H11A5 S8	
CQL16	S8b	Ph	COW54	S8a	LED	H11B1 S8	
CQS51L	S8a	LED	CQW60(L)		LED	H11B2 S8	
							~ 1.1.0

<sup>=</sup> series

<sup>=</sup> Accessories

<sup>=</sup> Infrared devices

LED = Light-emitting diodes

M = Microwave transistors

PhC = Photocouplers

SEN = Sensors

type no.	book	section	type no.	book	section	type no.	book	sectio
H11B3	S8b	PhC	LTE42005S	S11	M	OM345	S10	WBM
H11B255	S8b	PhC	LTE42008R	S11	М	OM350	S10	WBM
KMZ 1OA	S13	SEN	LTE42012R	S11	M	OM360	S10	WBM
KMZ 10B	S13	SEN	LV1721E50R	S11	M	OM361	S10	WBM
KMZ 10C	S13	SEN	LV2024E45R		M	0М370	S10	WBM
KP100A	<b>S13</b>	SEN	LV2327E40R	S11	M	ом386В	S13	SEN
KP101A	S13	SEN	LV3742E16R	S11	M	OM386M	S13	SEN
KPZ2OG	S13	SEN	LV3742E24R	S11	M	OM387B	S13	SEN
KPZ21G	S13	SEN	LWE2015R	S11	M	OM387M	S13	SEN
KTY81*	S13	SEN	LWE2025R	S11	М	OM388B	S13	SEN
KTY83*	S13	SEN	LZ1418E100	RS11	M	ом389В	<b>S13</b>	SEN
KTY84*	S13	SEN	MCA230	S8b	PhC	OM931	S4a	P
LAE2001R	S11	M	MCA231	S8b	PhC	OM961	S4a	P
LAE4001Q	S11	M	MCA255	S8b	PhC	OSB9115	S2a	St
LAE4001R	S11	M	MCT2	S8b	PhC	OSB9215	S2a	St
LAE4002S	S11	M	MCT26	S8b	PhC	OSB9415	S2a	St
LAE6000Q	S11	M	MKB12040WS	S11	M	OSM9115	S2a	St
LBE 1004R	S11	M	MKB12100WS	S11	M	OSM9215	S2a	St
LBE1010R	S11	M	MKB12140W	S11	M	OSM9415	S2a	St
LBE2003S	S11	M	M06075B200	ZS11	M	OSM9510	S2a	St
LBE2005Q	S11	M	M06075B400		M	OSM9511	S2a	St
LBE2008T	S11	M	MRB12175YR		M	OSM9512	S2a	St
LBE2009S	S11	M	MRB12350YR		М	0559115	S2a	St
LCE1010R	S11	М	MS1011B700	YS11	M	0559215	S2a	St
LCE2003S	S11	M	MS6075B800	ZS11	M	0559415	S2a	St
LCE2005Q	S11	М	MSB12900Y	S11	М	P2105	S8b	I
LCE2008T	S11	M	MZO912B75Y		M	PBMF4391	S5	FET
LCE2009S	S11	M	MZO912B1503		M	PBMF4392	S5	FET
LJE42002T	S11	M	OM286; M	S13	SEN	PBMF4393	S5	FET
LKE 1004R	S11	M	OM287; M	S13	SEN	PDE 100 10	S11	M
LKE2002T	S11	M	OM320	S10	WBM	PDE1003U	S11	M
LKE2004T	S11	М	OM321	S10	WBM	PDE 1005U	S11	М
LKE2015T	S11	M	OM322	S10	WBM	PDE1010U	S11	M
LKE21004R	S11	M	OM323	S10	WBM	PEE 100 1U	S11	М
LKE21015T	S11	M	OM323A	<b>S10</b>	WBM	PEE1003U	S11	M
LKE21050T	S11	M	OM335	s10	WBM	PEE 1005U	S11	M
LKE27010R	S11	M	OM336	S10	WBM	PEE1010U	S11	M
LKE27025R	S11	M	OM337	S10	WBM	PH2222;R	S3	Sm
LKE32002T	S11	M	OM337A	S10	WBM	PH2222A; R	S3	Sm
LKE32004T	S11	M	OM339	S10	WBM	PH2369	\$3	Sm

FET = Field-effect transistors
I = Infrared devices

M = Microwave transistors

Mm = Microminiature semiconductors for hybrid circuits

P = Low-frequency power transistors

PhC = Photocouplers

R = Rectifier diodes

SD = Small-signal diodes

SEN = Sensors

Sm = Small-signal transistors

SP = Low-frequency switching power transistors

St = Rectifier stacks

WBM = Wideband hybrid IC modules

#### **INDEX**

PH2907A;R S3 Sm	type no.	book	section	type no.	book	section	type no.	book	section
PH2907A;R S3 Sm	PH2907:R	S3	Sm	PML1.4448	S1	SD	RZ1214B60W	S11	М
PH2955T	•						1		M
PH3055T	•				S1/S7	SD			M
PH5415   S3   Sm				1	,				М
PH13002 S4b SP PPC5001T S11 M R23135B15U S11 M PH13003 S4b SP PQC5001T S11 M R23135B15U S11 M R23135B15U S11 M R23135B15U S11 M R23135B25U S11 M R23135B30W S11 M R23135B30W S11 M R23135B30W S11 M R23135B30W S11 M PKB3003U S11 M PTB32001X S11 M R2B12350Y S11 M R2B12350Y S11 M R2B12350Y S11 M R2B12350Y S11 M R2B12350Y S11 M R2B12350Y S11 M R2B12350Y S11 M R2B12350Y S11 M R2B12350Y S11 M R2B123001U S11 M PTB32005X S11 M SL5500 S8b P PKB23001U S11 M PTB42001X S11 M SL5501 S8b P PKB23005U S11 M PTB42001X S11 M SL5504S S8b P PKB23005U S11 M PVB42004X S11 M SL5504S S8b P PKB32003U S11 M PVB42004X S11 M SL5505S S8b P PKB32003U S11 M PVB42004X S11 M SL5505S S8b P PKB32003U S11 M PXT3904 S7 Mm SL5511 S8b P PKB32003U S11 M PXT3904 S7 Mm PZ1418B30U S11 M TIP30* S4a P PMBF4392 S7 Mm PZ1418B30U S11 M TIP31* S4a P PMBF4392 S7 Mm PZ1418B30U S11 M TIP31* S4a P PMBF4392 S7 Mm PZ1418B30U S11 M TIP31* S4a P PMBF4390 S7 Mm PZ2024B20U S11 M TIP33* S4a P PMBT3903/4 S7 Mm PZ2024B20U S11 M TIP33* S4a P PMBT3903/4 S7 Mm PZ2024B20U S11 M TIP33* S4a P PMBT3903/4 S7 Mm PZ2024B20U S11 M TIP33* S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP33* S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP33* S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP34* S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP34* S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP34* S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP41* S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP44 S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP44 S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP44 S4a P PMBT3906 S7 Mm PZ2024B20U S11 M TIP45 S4a P PMBT3906 S7 Mm PZ1910 S8b I TIP110 S4a P PMBT392/93 S7 Mm RPY101 S8b I TIP110 S4a P PMBT392/93 S7 Mm RPY103 S8b I TIP111 S4a P PMBT392/93 S7 Mm RPY103 S8b I TIP110 S4a P PMBT392/93 S7 Mm RPY103 S8b I TIP110 S4a P PMBT392/93 S7 Mm RPY103 S8b I TIP110 S4a P PMBT392/93 S7 Mm RPY107 S8b I TIP115 S4a P PMBT392/93 S7 Mm RPY103 S8b I TIP116 S4a P PMBT392/93 S7 Mm RPY103 S8b I TIP11					S8b	PhC	i e		М
PH13002	PH5416	S3	Sm	PO44A	S8b	PhC	RZ2833B45W	S11	М
PH13003 S4b SP PQC5001T S11 M RZ3135B15W S11 M PHSD51 S2a R PTB23001X S11 M RZ3135B25U S11 M RZ3135B25U S11 M PTB23003X S11 M RZ3135B30W S11 M RZ3135B30W S11 M RZ3135B30W S11 M RZ3135B30W S11 M PTB23005X S11 M RZB1210OY S11 M PTB32001X S11 M RZB1210OY S11 M PTB32001X S11 M RZB1235OY S11 M RZB1235OY S11 M RZB1235OY S11 M PTB32005X S11 M RZB1235OY S11 M PTB32005X S11 M RZB1235OY S11 M PTB32005X S11 M SL5500 S8b P PKB23001U S11 M PTB42001X S11 M SL5500 S8b P PKB23005U S11 M PTB42001X S11 M SL5504 S8b P PKB23005U S11 M PTB42003X S11 M SL5504 S8b P PKB23005U S11 M PTB42003X S11 M SL5504 S8b P PKB23005U S11 M PVB42004X S11 M SL5504 S8b P PKB25001U S11 M PVB42004X S11 M SL5505S S8b P PKB32003U S11 M PXT3904 S7 Mm SL5505S S8b P PKB32003U S11 M PXT3904 S7 Mm SL5501 S8b P PKB32005U S11 M PXT3904 S7 Mm PZ1418B15U S11 M T1P30* S4a P PMBF4392 S7 Mm PZ1418B15U S11 M T1P31* S4a P PMBF4392 S7 Mm PZ1721B12U S11 M T1P31* S4a P PMBF4392 S7 Mm PZ1721B25U S11 M T1P31* S4a P PMBT2907/A S7 Mm PZ1721B25U S11 M T1P33* S4a P PMBT3903/4 S7 Mm PZ1721B25U S11 M T1P33* S4a P PMBT3907/A S7 Mm PZ1721B25U S11 M T1P31* S4a P PMBT3907/A S7 Mm PZB16035U S11 M T1P31* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB16035U S11 M T1P41* S4a P PMBT3906 S7 Mm PZB1700 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3907 S8b I T1P41 S4a P PMBT3				I control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the cont					M
PHSD51         S2a         R         PTB23001X         S11         M         RZ3135B25U         S11         M           PKB3003U         S11         M         PTB23003X         S11         M         RZ3135B30W         S11         M           PKB3005U         S11         M         PTB23005X         S11         M         RZB12350Y         S11         M           PKB2005U         S11         M         PTB32003X         S11         M         RZB12350Y         S11         M           PKB20010U         S11         M         PTB32005X         S11         M         RZB12350Y         S11         M           PKB23001U         S11         M         PTB32005X         S11         M         RZ21214B300YS11         M           PKB23001U         S11         M         PTB42005X         S11         M         RZ15500         S8b         P           PKB23005U         S11         M         PTB42003X         S11         M         SL5504         S8b         P           PKB32005U         S11         M         PV3742B4X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PV				POC5001T	S11	M	RZ3135B15W	S11	M
PKB3001U         S11         M         PTB23003X         S11         M         RZ3135B30W         S11         M           PKB3003U         S11         M         PTB23005X         S11         M         RZB12100Y         S11         M           PKB12005U         S11         M         PTB32003X         S11         M         RZB12350Y         S11         M           PKB2001U         S11         M         PTB32005X         S11         M         RZB1214B300YS11         M           PKB23001U         S11         M         PTB42005X         S11         M         SL5500         S8b         P           PKB23003U         S11         M         PTB42003X         S11         M         SL5504         S8b         P           PKB32005U         S11         M         PTB42003X         S11         M         SL5504         S8b         P           PKB32003U         S11         M         PVB42003X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PVB42003X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PVB420				~					M
PKB3005U         S111         M         PTB32001X         S11         M         RZB12350Y         S11         M           PKB12005U         S11         M         PTB32003X         S11         M         RZZ1214B300YS11         M           PKB2001U         S11         M         PTB32005X         S11         M         SL5500         S8b         P           PKB23003U         S11         M         PTB42001X         S11         M         SL5501         S8b         P           PKB23005U         S11         M         PTB42003X         S11         M         SL5504         S8b         P           PKB23005U         S11         M         PVB42003X         S11         M         SL5504         S8b         P           PKB32001U         S11         M         PVB42004X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PVB42004X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PVB42004X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PVB42004X<				}			the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon		М
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PKB12005U         S111         M         PTB32003X         S111         M         RZZ1214B300YS11         M           PKB2001U         S11         M         PTB32005X         S11         M         SL5500         S8b         P           PKB23001U         S11         M         PTB42001X         S11         M         SL5501         S8b         P           PKB23005U         S11         M         PTB42003X         S11         M         SL5504         S8b         P           PKB25006T         S11         M         PVB42004X         S11         M         SL5504         S8b         P           PKB32001U         S11         M         PVB42004X         S11         M         SL5505S         S8b         P           PKB32005U         S11         M         PVB73906         S7         Mm         SL5505S         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         TIP29*         S4a         P           PMBF4391         S7         Mm         PZ1418B15U         S11         M         TIP30*         S4a         P           PMBF4392         S7         Mm         PZ1418B30U							RZB12350Y	S11	М
PKB20010U         S11         M         PTB32005X         S11         M         SL5500         S8b         P           PKB23001U         S11         M         PTB42001X         S11         M         SL5501         S8b         P           PKB23005U         S11         M         PTB42003X         S11         M         SL5504         S8b         P           PKB25006T         S11         M         PVB42004X         S11         M         SL5504S         S8b         P           PKB32001U         S11         M         PVB42004X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PVB42004X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PVB42004X         S11         M         SL5505S         S8b         P           PKB32003U         S11         M         PXT3906         S7         Mm         SL5501S         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         TIP29*         S4a         P           PMB74391         S7         Mm         PXT				1					M
PKB23001U         S11         M         PTB42001X         S11         M         SL5501         S8b         P           PKB23003U         S11         M         PTB42002X         S11         M         SL5502R         S8b         P           PKB23005U         S11         M         PV3742B4X         S11         M         SL5504S         S8b         P           PKB32001U         S11         M         PV3742B4X         S11         M         SL5504S         S8b         P           PKB32003U         S11         M         PV42004X         S11         M         SL5505S         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         SL5501S         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         SL5501S         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         TIP29*         S4a         P           PKB32005U         S11         M         PXT3906         S7         Mm         TIP29*         S4a         P           PKB32005U         S11         M         PXT193							SL5500	S8b	PhC
PKB23005U         S11         M         PTB42003X         S11         M         SL5504         S8b         P           PKB25006T         S11         M         PV3742B4X         S11         M         SL5504S         S8b         P           PKB32001U         S11         M         PVB42004X         S11         M         SL5505S         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         SL5511         S8b         P           PMBF4391         S7         Mm         PZ1418B15U         S11         M         T1P30*         S4a         P           PMBF4392         S7         Mm         PZ1418B30U         S11         M         T1P30*         S4a         P           PMBF4392         S7         Mm         PZ1721B12U         S11         M         T1P31*         S4a         P           PMBF4392         S7         Mm         PZ1721B12U         S11         M         T1P31*         S4a         P           PMBT2202/A         S7         Mm         PZ1721B25U         S11         M         T1P33*         S4a         P           PMBT3906         S7         Mm         PZ									PhC
PKB23005U         S11         M         PTB42003X         S11         M         SL5504         S8b         P           PKB25006T         S11         M         PV3742B4X         S11         M         SL5504S         S8b         P           PKB32001U         S11         M         PVB42004X         S11         M         SL5505S         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         SL5511         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         TIP29*         S4a         P           PMBF4391         S7         Mm         PZ1418B15U         S11         M         TIP30*         S4a         P           PMBF4392         S7         Mm         PZ1418B30U         S11         M         TIP30*         S4a         P           PMBF4392         S7         Mm         PZ1721B12U         S11         M         TIP31*         S4a         P           PMBF4392         S7         Mm         PZ1721B12U         S11         M         TIP31*         S4a         P           PMBT2907/A         S7         Mm         PZ20	PKB23003II	S11	M	PTB42002X	S11	М	SL5502R	S8b	PhC
PKB25006T         S11         M         PV3742B4X         S11         M         SL5504S         S8b         P           PKB32001U         S11         M         PVB42004X         S11         M         SL5505S         S8b         P           PKB32003U         S11         M         PXT3904         S7         Mm         SL55011         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         TIP29*         S4a         P           PMBF4391         S7         Mm         PZ1418B15U         S11         M         TIP30*         S4a         P           PMBF4392         S7         Mm         PZ1721B12U         S11         M         TIP31*         S4a         P           PMBT4392         S7         Mm         PZ1721B25U         S11         M         TIP32*         S4a         P           PMBT2207/A         S7         Mm         PZ1721B25U         S11         M         TIP33*         S4a         P           PMBT3903/4         S7         Mm         PZ2024B10U         S11         M         TIP34*         S4a         P           PMBT3906         S7         Mm         P				1					PhC
PKB32001U         S11         M         PVB42004X         S11         M         SL5505S         S8b         P           PKB32003U         S11         M         PXT3904         S7         Mm         SL5511         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         TIP29*         S4a         P           PMBF4391         S7         Mm         PZ1418B15U         S11         M         TIP30*         S4a         P           PMBF4392         S7         Mm         PZ1418B30U         S11         M         TIP31*         S4a         P           PMBF4392         S7         Mm         PZ1721B12U         S11         M         TIP32*         S4a         P           PMBT2202/A         S7         Mm         PZ1721B25U         S11         M         TIP34*         S4a         P           PMBT3903/4         S7         Mm         PZ2024B10U         S11         M         TIP34*         S4a         P           PMBT3903/4         S7         Mm         PZ2024B20U         S11         M         TIP41*         S4a         P           PMBT6428/9         S7         Mm <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>PhC</td></td<>									PhC
PKB32003U         S11         M         PXT3904         S7         Mm         SL5511         S8b         P           PKB32005U         S11         M         PXT3906         S7         Mm         TIP29*         S4a         P           PMBF4391         S7         Mm         PZ1418B15U         S11         M         TIP30*         S4a         P           PMBF4392         S7         Mm         PZ1721B12U         S11         M         TIP31*         S4a         P           PMBF4392         S7         Mm         PZ1721B12U         S11         M         TIP31*         S4a         P           PMBT4392         S7         Mm         PZ1721B25U         S11         M         TIP32*         S4a         P           PMBT2202/AB300         S11         M         TIP33*         S4a         P           PMBT3903/4         S7         Mm         PZ2024B10U         S11         M         TIP34*         S4a         P           PMBT3906         S7         Mm         PZ816035U         S11         M         TIP41*         S4a         P           PMBT405/06         S7         Mm         PZ827020U         S11         M							l		PhC
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PMBF4391         S7         Mm         PZ1418B15U S11         M         TIP30*         S4a         PPMBF4392         S7         Mm         PZ1418B30U S11         M         TIP31*         S4a         PPMBF4392         S7         Mm         PZ1721B12U S11         M         TIP32*         S4a         PPMBF4392         S7         Mm         PZ1721B25U S11         M         TIP32*         S4a         PPMBF4392         S7         Mm         PZ1721B25U S11         M         TIP33*         S4a         PPMBF4393         S4a         PPMBT33*         S4a         PPMBT34*         S4a <td>DKB32005II</td> <td>C11</td> <td>м</td> <td>PYT3906</td> <td>97</td> <td>Mm</td> <td>ттр29*</td> <td>S4a</td> <td>р</td>	DKB32005II	C11	м	PYT3906	97	Mm	ттр29*	S4a	р
PMBF4392         S7         Mm         PZ1418B30U S11         M         TIP31*         S4a         PPMBF4392         S7         Mm         PZ1721B12U S11         M         TIP32*         S4a         PPMBT2222/A         S7         Mm         PZ1721B25U S11         M         TIP33*         S4a         PPMBT2907/A         S7         Mm         PZ2024B10U S11         M         TIP34*         S4a         PPMBT330         S4a         PPMBT33903/4         S7         Mm         PZ2024B20U S11         M         TIP44*         S4a         PPMBT3906         S7         Mm         PZB16035U S11         M         TIP42*         S4a         PPMBT6428/9         S7         Mm         PZB27020U S11         M         TIP47         S4a         PPMBTA05/06         S7         Mm         RPY97         S8b         I         TIP48         S4a         PPMBTA13/14         S7         Mm         RPY100         S8b         I         TIP48         S4a         PPMBTA63/64         S7         Mm         RPY101         S8b         I         TIP10         S4a         PPMBTA92/93         S7         Mm         RPY102         S8b         I         TIP110         S4a         PPMBTA92/93         S7         Mm         RPY103         S8b         I				ì			i .		
PMBF4392         S7         Mm         PZ1721B12U S11         M         TIP32*         S4a         P           PMBT2222/A         S7         Mm         PZ1721B25U S11         M         TIP33*         S4a         P           PMBT2907/A         S7         Mm         PZ2024B10U S11         M         TIP34*         S4a         P           PMBT3903/4         S7         Mm         PZ2024B20U S11         M         TIP41*         S4a         P           PMBT3906         S7         Mm         PZB16035U S11         M         TIP42*         S4a         P           PMBT6428/9         S7         Mm         PZB27020U S11         M         TIP47         S4a         P           PMBTA05/06         S7         Mm         RPY97         S8b         I         TIP48         S4a         P           PMBTA42/43         S7         Mm         RPY100         S8b         I         TIP49         S4a         P           PMBTA63/64         S7         Mm         RPY102         S8b         I         TIP110         S4a         P           PML24148         S1         SD         RPY107         S8b         I         TIP111         S4a         P				1					P
PMBT2222/A         S7         Mm         PZ1721B25U         S11         M         TIP33*         S4a         P           PMBT2907/A         S7         Mm         PZ2024B10U         S11         M         TIP34*         S4a         P           PMBT3903/4         S7         Mm         PZ2024B20U         S11         M         TIP41*         S4a         P           PMBT3906         S7         Mm         PZB16035U         S11         M         TIP42*         S4a         P           PMBT6428/9         S7         Mm         PZB27020U         S11         M         TIP47         S4a         P           PMBTA05/06         S7         Mm         RPY97         S8b         I         TIP48         S4a         P           PMBTA42/43         S7         Mm         RPY100         S8b         I         TIP49         S4a         P           PMBTA55/56         S7         Mm         RPY101         S8b         I         TIP110         S4a         P           PMBTA63/64         S7         Mm         RPY103         S8b         I         TIP111         S4a         P           PMLL4148         S1         SD         RPY109 <td></td> <td></td> <td></td> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td>				1					
PMBT3903/4         S7         Mm         PZ2024B20U S11         M         TIP41*         S4a         PPMBT3906         S7         Mm         PZB16035U S11         M         TIP42*         S4a         PPMBT6428/9         S7         Mm         PZB27020U S11         M         TIP47         S4a         PPMBTA05/06         S7         Mm         RPY97         S8b         I         TIP48         S4a         PPMBTA13/14         S7         Mm         RPY100         S8b         I         TIP48         S4a         PPMBTA13/14         S7         Mm         RPY101         S8b         I         TIP49         S4a         PPMBTA13/14         S7         Mm         RPY101         S8b         I         TIP50         S4a         PPMBTA13/14         S7         Mm         RPY102         S8b         I         TIP110         S4a         PPMBTA13/14         S7         Mm         RPY102         S8b         I         TIP110         S4a         PPMBTA13/14         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA13/14         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA13/14         S7         Mm         RPY103         S8b         I									P
PMBT3903/4         S7         Mm         PZ2024B20U S11         M         TIP41*         S4a         PPMBT3906         S7         Mm         PZB16035U S11         M         TIP42*         S4a         PPMBT6428/9         S7         Mm         PZB27020U S11         M         TIP47         S4a         PPMBTA05/06         S7         Mm         RPY97         S8b         I         TIP48         S4a         PPMBTA13/14         S7         Mm         RPY100         S8b         I         TIP48         S4a         PPMBTA05/06         S7         Mm         RPY101         S8b         I         TIP49         S4a         PPMBTA05/06         S4a         PPMBTA05/06         S4a         PPMBTA05/06         S7         Mm         RPY101         S8b         I         TIP49         S4a         PPMBTA05/06         S4a         PPMBTA05/06 <t< td=""><td>PMRT2907/A</td><td>S7</td><td>Mm</td><td>PZ2024B10U</td><td>S11</td><td>M</td><td>TIP34*</td><td>S4a</td><td>P</td></t<>	PMRT2907/A	S7	Mm	PZ2024B10U	S11	M	TIP34*	S4a	P
PMBT3906         S7         Mm         PZB16035U         S11         M         TIP42*         S4a         PPMBT6428/9         S7         Mm         PZB27020U         S11         M         TIP47         S4a         PPMBTA05/06         S7         Mm         RPY97         S8b         I         TIP48         S4a         PPMBTA13/14         S7         Mm         RPY97         S8b         I         TIP48         S4a         PPMBTA13/14         S7         Mm         RPY100         S8b         I         TIP49         S4a         PPMBTA13/14         S7         Mm         RPY101         S8b         I         TIP50         S4a         PPMBTA13/14         S7         Mm         RPY102         S8b         I         TIP110         S4a         PPMBTA13/14         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA13/14         S4a         PPMBTA13/14         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA13/14         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA13/14         S7         Mm         RPY107         S8b         I         TIP112         S4a         PPMBTA14							TIP41*	S4a	P
PMBT6428/9         S7         Mm         PZB27020U         S11         M         TIP47         S4a         PPMBTA05/06         S7         Mm         RPY97         S8b         I         TIP48         S4a         PPMBTA13/14         S7         Mm         RPY100         S8b         I         TIP49         S4a         PPMBTA42/43         S7         Mm         RPY101         S8b         I         TIP50         S4a         PPMBTA55/56         S7         Mm         RPY102         S8b         I         TIP110         S4a         PPMBTA63/64         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP111         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         PPMBTA92/93         S7         Mm         RPY109         S8b         I         TIP115         S4a         PPMBTA92/93         S7         Mm         RPY109         S8b         I         TIP115         S4a         PPMBTA92/93         S7         S8         S4a         PPMBTA92/93         S8         S4a         PPMBTA92/93         S8         S4a         PPMBTA92/93							1		P
PMBTA05/06         S7         Mm         RPY97         S8b         I         TIP48         S4a         P           PMBTA13/14         S7         Mm         RPY100         S8b         I         TIP49         S4a         P           PMBTA42/43         S7         Mm         RPY101         S8b         I         TIP50         S4a         P           PMBTA55/56         S7         Mm         RPY102         S8b         I         TIP110         S4a         P           PMBTA63/64         S7         Mm         RPY103         S8b         I         TIP111         S4a         P           PMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         P           PML4148         S1         SD         RPY109         S8b         I         TIP115         S4a         P           PML4150         S1         SD         RV3135B5X         S11         M         TIP116         S4a         P           PML4151         S1         SD         RX1214B300YS11         M         TIP117         S4a         P				1			1		P
PMBTA42/43         S7         Mm         RPY101         S8b         I         TIP50         S4a         PPMBTA55/56         S7         Mm         RPY102         S8b         I         TIP110         S4a         PPMBTA63/64         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP111         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         PPMBTA92/93         S7         Mm         RPY109         S8b         I         TIP115         S4a         PPMBTA92/93         S7         Mm         RPY109         S8b         I         TIP115         S4a         PPMBTA92/93         S7         MM         TIP116         S4a         PPMBTA92/93         S7         MM         TIP117         S4a         PPMBTA92/93         S7         S8b         I         TIP115	•			1			TIP48	S4a	P
PMBTA42/43         S7         Mm         RPY101         S8b         I         TIP50         S4a         PPMBTA55/56         S7         Mm         RPY102         S8b         I         TIP110         S4a         PPMBTA63/64         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP111         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         PPMBTA92/93         S7         Mm         RPY109         S8b         I         TIP115         S4a         PPMBTA92/93         Mm         RPY109	PMRTA13/14	<b>97</b>	Mm	RPY 100	S8b	r	TIP49	S4a	P
PMBTA55/56         S7         Mm         RPY102         S8b         I         TIP110         S4a         PPMBTA63/64         S7         Mm         RPY103         S8b         I         TIP111         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         PPMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         PPMBTA92/93         S7         Mm         RPY109         S8b         I         TIP115         S4a         PPMBTA92/93         S1         S2         RX1244B300YS11         M         TIP117         S4a         PPMBTA92/93         S1         S1         S2         S3	•			1					p
PMBTA63/64         S7         Mm         RPY103         S8b         I         TIP111         S4a         P           PMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         P           PMLL4148         S1         SD         RPY109         S8b         I         TIP115         S4a         P           PMLL4150         S1         SD         RV3135B5X         S11         M         TIP116         S4a         P           PMLL4151         S1         SD         RX1214B300YS11         M         TIP117         S4a         P	•			· ·					P
PMBTA92/93         S7         Mm         RPY107         S8b         I         TIP112         S4a         P           PMLL4148         S1         SD         RPY109         S8b         I         TIP115         S4a         P           PMLL4150         S1         SD         RV3135B5X         S11         M         TIP116         S4a         P           PMLL4151         S1         SD         RX1214B300YS11         M         TIP117         S4a         P				1					p
PMLL4150 S1 SD RV3135B5X S11 M TIP116 S4a P PMLL4151 S1 SD RX1214B300YS11 M TIP117 S4a P	•			1					P
PMLL4150 S1 SD RV3135B5X S11 M TIP116 S4a P PMLL4151 S1 SD RX1214B300YS11 M TIP117 S4a P	PMT.T.4148	S1	SD	RPY 109	S8b	T	TIP115	S4a	P
PMLL4151 S1 SD + RX1214B300YS11 M TIP117 S4a P									P
				l .					P
Time 100 by Sb   Minimove by the									P
				)	~		1		P

<sup>\* =</sup> series

R = Rectifier diodes

SD = Small-signal diodes

Vrf = Voltage reference diodes

I = Infrared devices

M = Microwave transistors

P = Low-frequency power transistors

PhC = Photocouplers

	type no.	book	section	type no.	book	section	type no.	book	section
	TIP122	S4a	P	1N4002G	S1	R	2N2905A	<b>s</b> 3	Sm
	TIP125	S4a	P	1N4003G	<b>S1</b>	R	2N29O6	<b>S</b> 3	Sm
	TIP126	S4a	P	1N4004G	S1	R	2N2906A	<b>S</b> 3	Sm
	TIP127	S4a	P	1N4005G	51	R	2N2907	\$3	Sm
	TIP130	S4a	P	1N4006G	S1	R	2N2907A	<b>s</b> 3	Sm
	TIP131	S4a	P	1N4007G	<b>S</b> 1	R	2N3O19	<b>S</b> 3	Sm
	TIP132	S4a	P	1N4148	S1	SD	2N3020	S3	Sm
	TIP135	S4a	P	1N4150	S1	SD	2N3O53	<b>S</b> 3	Sm
	TIP136	S4a	P	1N4151	S1	SD	2N3375	S6	RFP
	TIP137	S4a	P	1N4153	51	SD	2N3553	S6	RFP
	TIP140	S4a	P	1N4446	<b>S</b> 1	SD	2N3632	s6	RFP
	TIP141	S4a	P	1N4448	S1	SD	2N3822	\$5	FET
1	TIP145	S4a	P	1N4531	<b>S1</b>	SD	2N3823	S5	FET
	TIP146	S4a	P	1N4532	S1	SD	2N3866	S6	RFP
	TIP147	S4a	P	1N5059	S1	R	2N3903	<b>S</b> 3	Sm
	TIP2955	S4a	P	1N5060	<b>S1</b>	R	2N39O4	s3	Sm
	TIP3055	S4a	P	1N5061	S1	R	2N3905	<b>S</b> 3	Sm
	1N821;A	S1	Vrf	1N5062	S1	R	2N3906	53	Sm
1	1N823;A	S1	Vrf	1N5225B			2N3924	s6	RFP
	1N825; A	S1	Vrf	to	S1	SD	2N3926	S6	RFP
l	1N827;A	S1	Vrf	1N5267B			2N3927	s6	RFP
	1N829;A	S1 .	Vrf	2N918	S10	WBT	2N3966	S5	FET
	1N914	S1	SD	2N929	S3	Sm	2N4030	S3	Sm
	1N916	S1	SD	2N930	S3	Sm	2N4031	<b>S</b> 3	Sm
	1N3879	S2a	R	2N1613	\$3	Sm	2N4032	S3	Sm
	1N3880	S2a	R	2N1711	<b>S</b> 3	Sm	2N4O33	<b>S</b> 3	Sm
	1N3881	S2a	R	2N1893	S3	Sm	2N4091	S5	FET
	1N3882	S2a	R	2N2219	S3	Sm	2N4092	S5	FET
	1N3883	S2a	R	2N2219A	S3	Sm	2N4093	<b>S</b> 5	FET
	1N3889	S2a	R	2N2222	<b>S</b> 3	Sm	2N4123	<b>S</b> 3	Sm
	1N3890	S2a	R	2N2222A	<b>S</b> 3	Sm	2N4124	<b>S</b> 3	Sm
	1N3891	S2a	R	2N222ZA 2N2297	\$3	Sm	2N4125	S3	Sm
	1N3892	S2a	R	2N2368	S3	Sm	2N4126	S3	Sm
	1N3893	52a 52a	R	2N2369	53 53	Sm	2N4391	S5	FET
	1N3909	S2a	R	2N2369A	53	Sm	2N4392	S5	FET
	1112010	C2+	Б	2012402	<b>G</b> 3	c	201202	c c	rrm -
	1N3910	S2a	R	2N2483	<b>\$</b> 3	Sm	2N4393	S5	FET
1	1N3911	S2a	R	2N2484	S3	Sm	2N4427	S6	RFP
	1N3912	52a	R	2N29O4	. S3	Sm	2N4856	S5	FET
	1N3913	S2a	R	2N29O4A	S3	Sm	2N4857	S5	FET
	1N4001G	S1	R	2N2905	<b>S</b> 3	Sm	2N4858	<b>\$</b> 5	FET

A = Accessories

FET = Field-effect transistors
Ph = Photoconductive devices

PhC = Photocouplers
R = Rectifier diodes

RFP = R.F. power transistors and modules

SD = Small-signal diodes

Sm = Small-signal transistors

WBT = Wideband transistors

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type no. book section type no. book	
type no. book section type no. book	section
2N4859 S5 FET 56359d S2,4b	A
2N4860 S5 FET 56360a S2,4b	A
2N4861 S5 FET 56363 S2,4b	A
2N5400 S3 Sm 56364 S2,4b	A
2N5401 S3 Sm 56367 S2a/b	A
2N5415 S3 Sm 56368b S2,4b	A
2N5416 S3 Sm 56368c S2,4b	A
2N5550 S3 Sm 56369 S2,4b	A
2N5551 S3 Sm 56378 S2,4b	A
2N6659 S5 FET 56379 S2,4b	A
2N6660 S5 FET 56387a,b S4b	A
2N6661 S5 FET 56397 S8b	A
4N25 S8b PhC	
4N25A S8b PhC	
4N26 S8b PhC	
4N27 S8b PhC	
4N28 S8b PhC	
4N35 S8b PhC	
4N36 S8b PhC	
4N37 S8b PhC	
4N38 S8b PhC	
4N38A S8b PhC	
502CQF S8b Ph	
503CQF S8b Ph	
504CQL S8b Ph	
516CQF-B S8b Ph	
56201d S4b A	
56201j S4b A	
56245 S3,10 A	
56246 S3,10 A	
56261a S4b A	
56264 S2a/b A	
56295 S2a/b A	
56326 S4b A	
56339 S4b A	
56350	
56352 S4b A	
56353 S4b A	
56354 S4b A	
56359b S2,4b A	
56359c S2,4b A	

A = Accessories

FET = Field-effect transistors

Ph = Photoconductive devices

PhC = Photocouplers

Sm = Small-signal diodes

NOTES

DATA HANDBOOK SYSTEM



#### DATA HANDBOOK SYSTEM

Our Data Handbook System comprises more than 60 books with specifications on electronic components, subassemblies and materials. It is made up of four series of handbooks:

**ELECTRON TUBES** 

**BLUE** 

**SEMICONDUCTORS** 

RED

INTEGRATED CIRCUITS

**PURPLE** 

COMPONENTS AND MATERIALS

**GREEN** 

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T2b	Transmitting tubes for communications, ceramic types
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Т5	Cathode-ray tubes Instrument tubes, monitor and display tubes, C.R. tubes for special applications
Т6	Geiger-Müller tubes
Т8	Colour display systems Colour TV picture tubes, colour data graphic display tube assemblies, deflection units
Т9	Photo and electron multipliers
T10	Plumbicon camera tubes and accessories
T11	Microwave semiconductors and components
T12	Vidicon and Newvicon camera tubes
T13	Image intensifiers and infrared detectors
T15	Dry reed switches
T16	Monochrome tubes and deflection units  Black and white TV picture tubes, monochrome data graphic display tubes, deflection units

## SEMICONDUCTORS (RED SERIES)

The red series of data handbooks comprises:

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S2a	Power diodes
S2b	Thyristors and triacs
<b>S3</b>	Small-signal transistors
S4a	Low-frequency power transistors and hybrid modules
S4b	High-voltage and switching power transistors
<b>S</b> 5	Field-effect transistors
S6	R.F. power transistors and modules
<b>S7</b>	Surface mounted semiconductors
S8a	Light-emitting diodes
S8b	Devices for optoelectronics Optocouplers, photosensitive diodes and transistors, infrared light-emitting diodes and infrared sensitive devices, laser and fibre-optic components
S9	Power MOS transistors
S10	Wideband transistors and wideband hybrid IC modules
S11	Microwave transistors
S12	Surface acoustic wave devices
S13	Semiconductor sensors
S14	Liquid Crystal Displays

## INTEGRATED CIRCUITS (PURPLE SERIES)

The purple series of handbooks comprises:

ine purple ser	ios of Hariasosite comprises.	
IC01	Radic, audio and associated systems Bipolar, MOS	published 1986
IC02a/b	Video and associated systems Bipolar, MOS	published 1986
IC03	Integrated circuits for telephony Bipolar, MOS	published 1986
IC04	HE4000B !ogic family CMOS	published 1986
IC05N	HE4000B logic family — uncased ICs CMOS	published 1984
IC06N	High-speed CMOS; PC74HC/HCT/HCU Logic family	published 1986
IC08	ECL 10K and 100K logic families	published 1986
IC09N	TTL logic series	published 1986
IC10	Memories MOS, TTL, ECL	new issue 1987
IC11N	Linear LSI	published 1985
Supplement to IC11N	Linear LSI	published 1986
IC12	I <sup>2</sup> C-bus compatible ICs	not yet issued
IC13	Semi-custom Programmable Logic Devices (PLD)	new issue 1987
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1110 910011	001100 0	· uutu	Harrabooks	00111P11303

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C3	Loudspeakers
C4	Ferroxcube potcores, square cores and cross cores
<b>C</b> 5	Ferroxcube for power, audio/video and accelerator
C6	Synchronous motors and gearboxes
<b>C</b> 7	Variable capacitors
C8	Variable mains transformers
C9	Piezoelectric quartz devices
C11	Varistors, thermistors and sensors
C12	Potentiometers, encoders and switches
C13	Fixed resistors
C14	Electrolytic and solid capacitors
C15	Ceramic capacitors
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C17	Stepping motors and associated electronics
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